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IMPERIAL INSTITUTE OF ENTOMOLOGY

FARNHAM HOUSE LABORATORY

The war has reduced the opportunities for work based on Farnham House. Dr. Thompson, the Superintendent of the Laboratory, is now stationed at the Dominion Parasite Laboratory, Belleville, Ontario, Canada, where the Canadian Government has provided quarters and facilities for his work and that of his staff on the biological control of insect and plant pests. His senior assistant, Mr. E. Cameron, remains in the United Kingdom available for such work as can be done in that country.

Work on the natural enemies of animal and plant pests can now be undertaken in the temperate, subtropical and tropical regions of the Western Hemisphere. Entomologists in the countries of the British Commonwealth of Nations who wish to avail themselves of this opportunity for an extension of their biological control work are asked to communicate with Dr. W. R. Thompson, F.R.S., Imperial Parasite Service, Imperial Institute of Entomology, 228, Dundas Street, Belleville, Ontario, Canada, giving a detailed statement of their requirements.

Those who require parasites normally obtainable in the United Kingdom are asked to send their requests with similar details to The Director, Imperial Institute of Entomology, British Museum (Natural History), Cromwell Road, London, S.W.7, England.

Such division of orders should save time, but the parasites required will be obtained from whichever source is the more convenient or more promising. Dr. Thompson remains as Superintendent and in general charge.

GREENALL (A. F.). **Fighting the *Porina* Grass Caterpillar.**—*N. Z. J. Agric.* **60** no. 4 pp. 245–246, 2 figs. Wellington, N.Z., 1940.

For the last 7–8 years, attacks by subterranean grass caterpillars of the genus *Porina* have been increasing in extent and severity in pastures in South Otago, New Zealand. The adults of these Hepialids appear in early October. The larvae burrow into the subsoil and damage pastures during winter by coming up to feed on plant foliage : in a severe infestation, the ground becomes honeycombed with holes and the grass is sometimes entirely consumed, in which case it does not recover and is replaced by weeds.

It is known that the larvae feed almost entirely on surface leaves ; that they rarely attack a pasture in its first year and not very often after five years ; that larval activity is restricted by soil consolidation and damage reduced by vigorous plant growth and by light instead of close grazing ; that flooding pastures destroys the larvae and increases the vigour of the plants ; and that certified ryegrasses [*Lolium* spp.] are less prone to attack by *Porina* and recover from it better than uncertified perennial ryegrass [*L. perenne*], recovery being improved by top dressing with ammoniated superphosphate in the autumn after attack. Certain farm practices, based on the comparative immunity from attack under conditions in South Otago of cocksfoot grass [*Dactylis glomerata*], Montgomery red clover and crested dogstail [*Cynosurus cristatus*] and on methods of establishing cocksfoot grass that appear to be successful on the type of land most liable to infestation, have shown promise of control, although their efficacy has not been proved in every case. A method is described of establishing a resistant grass mixture, together with recommendations for grazing and maintenance.

HAMMOND (G. H.). **White Grubs and their Control in eastern Canada.** —*Publ. Canada Dep. Agric.* no. 668 (*Fmrs' Bull.* 86), 18 pp., 12 figs., 1 ref. Ottawa, 1940.

Of the 15 species of the genus *Lachnosterna* (*Phyllophaga*) that occur in eastern Canada, *L. anxia*, Lec., is the most common, widely distributed and injurious. *L. drakei*, Kby., is also widely distributed but is seldom important, and *L. futilis*, Lec., *L. fusca*, Fröl., and *L. rugosa*, Melsh., are serious pests in south-western Ontario but less injurious elsewhere. So far as is known, the life-cycle of all the species in eastern Canada lasts three years. The eggs are laid in late May, preferably in loose grass sod growing on light soil, and hatch in about four weeks. The larvae feed on the roots of plants for the rest of the summer, throughout the next summer and for a short time in the third, spending the winters, from late September to May, at depths of 6–15 ins. They pupate at a depth of about 4 ins. in June, and the adults emerge about a month later but remain in the ground until the following May. Their active life lasts from about 20th May to the end of June or early July, and during this period they hide in the soil during the day and fly and feed at night. Though a few adults are present each year in all districts, the years of main flight and consequently those of maximum injury, caused by second-year larvae, are different in different localities [*R.A.E.*, A **25** 367 ; **28** 425]. Lists are given of the trees and bushes on which the adults feed and of the plants attacked by the larvae. The damage caused by the larvae is by far the more serious,

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and is greatest in crops with fibrous roots, such as grasses and strawberry, in which the root system is cut through or completely destroyed, and in tubers. Root crops are also attacked.

One of the principal methods of control consists in selecting suitable crops to plant in infested land, particularly in the years in which second-year larvae are abundant. The common agricultural crops are therefore classified as susceptible, including potatoes, strawberries, maize and various grasses, moderately resistant, including small grains, beans, turnips and carrots, and very resistant, including clovers, and particularly sweet clover [*Melilotus*] and lucerne. In flight-years, light soil should be occupied by a hoed crop so that it is less attractive for oviposition. Although the larvae are attacked by many predacious enemies and are parasitised by a species of *Tiphia*, *Microphthalma michiganensis*, Tns., *M. nigra*, Macq. (*disjuncta*, auct.) and the fungi, *Cordyceps ravenelii* and *Metarrhizium anisopliae*, these exert little control. In districts in which damage by *Lachnosterna* is serious, the adults can be controlled by spraying their host trees with a suspension of 1 lb. lead arsenate in 20 gals. water. A single application on or before 26th May is sufficient unless the beetles are very abundant, when two applications, the first about 22nd May and the second about 1st June, are necessary. Suitable crop rotations and cultural control by shallow ploughing followed by repeated disking [*cf.* **23** 234] are discussed. Infestation of lawns, golf courses or small areas of grassland on which a valuable crop is to be planted can be prevented by dusting the grass with sulphur at the rate of 300 lb. per acre about 20th May, just as the adults are beginning to fly. In small gardens, the larvae should be removed by hand or killed by the application to the soil of 10 lb. lead arsenate per 1,000 sq. ft., followed by thorough raking or harrowing. The use of light-traps against the adults [*cf.* **28** 426] and of ashes, soot, salt or lime to control the larvae has proved valueless.

MILLER (N. C. E.). **Fruit Flies.**—*Malay. agric. J.* **28** no. 3 pp. 112–121, 4 figs., 1 ref. Kuala Lumpur, 1940.

The fruit-flies of economic importance in Malaya include at least four species, *Dacus* (*Chaetodacus*) *ferrugineus*, F., *D.* (*C.*) *cucurbitae*, Coq., *D.* (*C.*) *caudatus*, F., and *D.* (*C.*) *umbrosus*, F. All stages of *D. ferrugineus* are briefly described, and characters are given enabling the adults of the four species to be distinguished. The first three have all been recorded from cucurbits and *Eugenia* spp. and *D. ferrugineus* from a number of other fruits; in addition, *D. cucurbitae* occurs on chilli [*Capsicum*] and carambola [*Averrhoa carambola*], and *D. caudatus* on tomato. *D. umbrosus* appears to be essentially a pest of jak fruit [*Artocarpus integrifolia*] and its allies. In rearing experiments, considerable variation occurred in the duration of the different stages of *D. ferrugineus*, but this did not appear to be influenced by the kind or quality of the fruit provided, although the preoviposition period was shorter when the flies were supplied with cucumber than when they were given papaya.

In preliminary investigations on possible attractants for the flies, tests were carried out with a number of essential oils and other substances, but of these only bay oil and iso-eugenol were of any value. They attracted 608 and 751 adults of *D. ferrugineus* and 30 and 37 of *D. umbrosus*, respectively, over a period of three days, but the sexes

were not determined. Methyl eugenol, which was tested subsequently, attracted many males of *D. ferrugineus* but very few females. Carambola is the principal fruit attacked by *D. ferrugineus* at Serdang, and the fruits have a distinctive odour that is attractive to this Trypetid. When a jar containing the juice of the fruits, which was renewed after 17 days, was suspended in each of two carambola trees, the numbers of males and females caught in 35 days were 68 and 124, respectively. A bait containing $\frac{1}{8}$ oz. vanilla essence and $\frac{1}{2}$ oz. Scrubbs' ammonia, and another of $\frac{1}{8}$ oz. 40 per cent. formaldehyde and 13 oz. sugar, both in 26 oz. water, were good attractants for both sexes. Most of the females attracted by the latter contained well developed eggs.

In a brief discussion of control, it is pointed out that the use of baits cannot be more than a supplement to other measures, of which the chief is the removal of all damaged and fallen fruits, which should be buried in pits remote from the fruit trees or, if not too numerous, boiled in water. Both these methods also control larvae of the *Citrus* fruit borer, *Citripestis sagittiferella*, Moore. Protection against infestation is afforded by covering the fruits with paper, cloth or netting at the stage of development most susceptible to attack. This stage varies with the type of fruit, but it is generally safe to apply covers shortly after the fruit is formed.

O'Connor (B. A.). **Control of Coco-nut Treehoppers (*Sexava* spp.) by Dusting.**—*New Guinea agric. Gaz.* **6** no. 1 pp. 38–43. Rabaul, 1940.

In laboratory tests of dusts against the Tettigoniids of the genus *Sexava* that attack coconut in the Territory of New Guinea, Paris green and calcium and lead arsenates were the most effective [*R.A.E.*, A **27** 277]; Paris green gave the best results, although its price appeared to prohibit its use on a large scale and there were also indications of some risk of leaf-injury. During May–November 1938, field trials were carried out with these arsenicals in the form of dusts, since spraying was considered to be impracticable in coconut plantations. Over 30 tests were made on small plots of 64 trees and two applications were made on each of two 10-acre plots at an interval of about 100 days, since a second application is necessary to destroy the nymphs that hatch from eggs deposited before the first application. All eggs have time to hatch in 100 days, but no nymphs have time to become adults. Mortality was assessed by comparing populations on fronds cut from palms in the middle of each plot before treatment and 7–8 days later. The presence of numbers of dead *Sexava* on sheets spread below certain trees demonstrated that the action of the dusts was toxic and not merely repellent. The dusts were applied by means of a power duster, generally between 4 p.m. and sunset, when the possibility of rain could be forecast fairly accurately, since the value of the treatment is considerably reduced if rain washes away much of the dust before the Tettigoniids, which feed almost exclusively at night, become active. A steady air-drift or light breeze assists the operation, and good results were obtained when the breeze was quite strong. By dusting two rows of palms at a time, about 10 acres could be treated per hour.

Calcium arsenate was economically the most practical material; good coverage was obtained with the undiluted dust, and there was some indication of a delayed action, as it appeared to kill some of the

insects weeks after they ingested it. Paris green was comparable in cost but required a diluent, and hydrated lime was generally employed for this purpose ; kaolin and proprietary fillers were of value as diluents but not as adhesives. Lead arsenate was more expensive and less effective than calcium arsenate. In two experiments cited as typical, an application of calcium arsenate to three rows at a time and at the rate of 11½ lb. per acre, followed by only one night without rain, gave 100 per cent. reduction in population on two rows and 98 per cent. on the third, while an application of Paris green and lime (3 and 21 lb. per acre) to two rows at a time gave 96 per cent. After the work was completed, the author received a report of a dusting experiment carried out against *Sexava* on a plantation in the western islands of the Territory, in which great success was obtained with a mixture of lead arsenate and kaolin containing an adhesive.

The economics of dusting are discussed with reference to the cost of materials and application, depreciation of the machine, selling price of copra, and production of a 600-acre plantation severely infested by *Sexava* over a number of years. It is concluded that the profits from such a plantation would be greatly increased by a dusting campaign. In one less severely infested, dusting the whole area might not be economic or necessary, the main principle in successful control of *Sexava* being prompt and effective treatment of localised outbreaks to prevent the spread of infestation.

NAKAYAMA (S.). **Different Rates of Multiplication of** *Calandra oryzae*, **L., at the optimum Temperature in stored Rice.** [*In Japanese.*]—*Rep. Jap. Ass. Adv. Sci.* **15** no. 1 pp. 108–111. Tokyo, 1940.

Calandra oryzae, L., is an important pest of stored rice in Korea, where it continues to breed from late May to mid-October. The average duration of the life-cycle ranges from 33 days for eggs laid in July to 60 days for those laid in September. Optimum temperatures apparently occur in July and August. The temperature of rice in bags is higher than that of the surrounding air in storehouses, and the development of the weevil is correspondingly accelerated. Experiments showed that the rate of reproduction varied considerably.

TAKANO (S.). **On the Biological Control of Sugar-cane Insects in Formosa.** [*In Japanese.*]—*Rep. Jap. Ass. Adv. Sci.* **15** no. 2 pp. 231–233. Tokyo, 1940.

A review is given of work on the biological control of insect pests of sugar-cane in Formosa. Introduced parasites that have not become established include the Tachinid, *Diatraeophaga striatalis*, Tns., which was imported from Java against *Diatraea venosata*, Wlk., in 1916 ; *Encarsia flavoscutellum*, Zehnt., which was imported in 1926 against *Oregma* (*Ceratovacuna*) *lanigera*, Zehnt. ; and a Braconid and a Tachinid imported from the Philippines in 1928 against *Eucosma schistaceana*, Sn. *Telenomus* (*Phanurus*) *beneficiens*, Zehnt., was imported in 1916 from Java, where it parasitises the eggs of *D. venosata*. It also does so in Formosa [*R.A.E.*, A **27** 364], but attempts to rear it in large numbers in eggs of *Chilo infuscatellus*, Sn., had to be abandoned as it became so adapted to them it would no longer attack those of *Diatraea*. *Trichogramma australicum*, Gir., which parasitises the eggs of various moth-borers in Formosa [*loc. cit.*], has been bred in the eggs of *Sitotroga cerealella*, Ol., and liberated, with effective results in some districts,

and use has also been made of the ant, *Tetramorium guineense*, F., which attacks the moth-borer larvae [**27** 363]. *Coelophora saucia*, Muls., which was introduced from Tonkin against *O. lanigera*, is established in southern districts [*cf.* **22** 522] and another Coccinellid, *Synonycha grandis*, Thnb. [**26** 768], is reared in the laboratory and liberated for the control of this Aphid. The fungus, *Metarrhizium anisopliae*, was introduced from Hawaii in 1914 against white grubs, but later proved ineffective. The toad, *Bufo marinus*, which was introduced in 1935, also from Hawaii, has not been established in the sugar-cane fields.

KUWAYAMA (S.). **Biology of** *Lema cyanella sapporensis* **Mats.** [*In Japanese.*]—*Rep. Jap. Ass. Adv. Sci.* **15** no. 2 pp. 247–251, 5 figs. Tokyo, 1940.

Lema cyanella sapporensis, Mats., occurs in Sakhalin and also in Hokkaido, where it has one generation a year. The adults emerge from hibernation in late June, oviposit in July, and sometimes survive until August. This Criocerid has recently been observed on wheat, and, in captivity, the adults and larvae also fed on orchard grass, oats and barley, but not on rice. The eggs are laid in short rows on the leaves, chiefly on the upper surfaces, and hatch in about 6 days. The larvae feed for about 13 days and then form cocoons on the leaves. The prepupal and pupal stages last about 3 and 10 days, respectively.

MIWA (Y.). **On a Leaf-miner of** *Diospyros kaki* **in Formosa.** [*In Japanese.*]—*Formosan agric. Rev.* **36** no. 2 pp. 184–186, 1 fig. Taihoku, 1940.

Descriptions are given of all stages of the weevil, *Ochyromera miwai*, Kôno, the larvae of which mine the leaves of persimmon (*Diospyros kaki*) in Formosa, causing them to wither and drop. The eggs are laid singly in the basal parts of the leaf-stalks, and the larvae pupate in the soil in spring ; the pupal stage lasts 8 days.

SONAN (J.). **On the Insect Pests of Flax in Formosa.** [*In Japanese.*]—*Formosan agric. Rev.* **36** no. 6 pp. 577–586. Taihoku, 1940.

Brief notes are given on the bionomics of 28 insects that attack flax (*Linum usitatissimum*) in northern Formosa, where it is cultivated in winter. All are polyphagous. Serious injury is caused by the larvae of *Plusia* (*Phytometra*) *intermixta*, Warren, which feed on the tops of the stalks and sometimes occur in large numbers. This Noctuid also attacks vegetables, but the damage is less serious. The females deposit 1–5 eggs on the leaves and stalks, and the egg, larval and pupal stages last about 13, 30 and 14 days, respectively, in spring. There may be as many as 4 or 5 generations a year. The larvae of *Agrotis ypsilon*, Hfn., feed on the basal parts of the stalks, and those of *Cirphis unipuncta*, Haw., on the leaves, sometimes causing considerable damage. *Phytomyza atricornis*, Mg., mines the leaves.

SONAN (J.). **An Arctiid (***Diacrisia rhodophila* **Walk. var.** *rhodophilodes* **Hamp.) injurious to the Mulberry Tree in Formosa.** [*In Japanese.*] —*Formosan agric. Rev.* **36** no. 8 pp. 767–770, 1 fig. Taihoku, 1940.

The Arctiid, *Diacrisia rhodophila*, Wlk., var. *rhodophilodes*, Hmps., all stages of which are described, usually occurs near forests or in

mountainous regions in Formosa, where it apparently has 5 or 6 generations a year. The larvae feed on the leaves of mulberry and *Clerodendron* and pupate on fallen leaves. The eggs are laid in masses of 30–200 on the leaves at night, and the young larvae, which are gregarious, spin the leaves together.

SONAN (J.). **On the Life-history of the *Citrus* Locust (*Chondracris rosea* DeGeer) in Formosa.** [*In Japanese.*]—*Formosan agric. Rev.* **36** no. 9 pp. 839–842, 2 figs. Taihoku, 1940.

Chondracris rosea, DeG., is widely distributed in Formosa, where it occurs up to 5,000 ft. above sea level, causes serious injury to *Citrus* and hemp, and also feeds on cotton, cacao, sugar-cane, rice, ground-nuts [*Arachis hypogaea*], *Canna* and grasses. It has one generation a year and overwinters in the egg stage. The nymphs hatch in June or July, and become adult from August to December, mostly before the end of October. The adults, which are not gregarious, pair several times. Females lay 2–3 egg-masses containing 58 to 160 eggs. The eggs of this Acridid are attacked by various insects, including *Epicauta waterhousei*, Haag, *E. hirticornis*, Haag, *Mylabris phalerata*, Pall., and an unidentified species of *Scelio*.

MIWA (Y.) & MORIYAMA (T.). **Experiments with Baits for the Mango Fruit-fly (*Chaetodacus dorsalis* Hendel).** [*In Japanese.*]—*Formosan agric. Rev.* **36** nos. 8–10 pp. 685–716, 799–822, 895–914, 6 figs. Taihoku, 1940.

In orchard tests of baits for adults of *Dacus* (*Chaetodacus*) *ferrugineus dorsalis*, Hend., in Formosa in 1939, the best results were given by a mixture of soap solution, methyl eugenol, lemongrass oil and water, but most of the flies taken were males. The average number of flies caught per day in a trap containing this mixture operated from early October to early December was 24·8. Most of the flies were taken between September and mid-October, the maximum number in a single trap (104) being recorded on 3rd September. Very few were taken after harvest.

TAKAHASHI (R.). **Observations on the Lac Insect in Siam.** [*In Japanese.*]—*Formosan agric. Rev.* **36** no. 11 pp. 975–994, 1 pl., 5 figs. Taihoku, 1940.

Laccifer lacca, Kerr, is widely distributed in Siam, but lac cultivation is practised only in the northern and north-eastern regions. The usual host-tree is *Pithecolobium* (*Samanea*) *saman*, but *Butea frondosa*, *Albizzia* sp., *Zizyphus jujuba* and *Euphoria longana* are also used. The branches are sometimes killed by the Coccid, but the trees usually survive. It has two generations a year in Siam; the first, which develops during the rainy season (May–November), produces much lac, but the second, which develops in the dry season (November to April), is less productive. Considerable mortality is caused by *Eublemma* sp. and a Chalcidoid, which are common throughout Siam, and also by the crawlers becoming attached to the webs of Embioptera, moths and spiders on the branches. Insect pests of the host-trees include the Lycaenid, *Castalius rosimon*, F., the Pyralid, *Pagyda traducalis*, Zell., and a Capsid, which are very injurious to *Zizyphus*

jujuba, and *Aspidiotus destructor*, Sign., which infests *P. saman*. The technique of cultivation and the quality of the lac crop in Siam are discussed.

KAYASHIMA (I.). **On a Bruchid injurious to the Seeds of Ambari Hemp.** [*In Japanese.*]—*Formosan agric. Rev.* **36** no. 11 pp. 1030–1033, 5 figs. Taihoku, 1940.

Descriptions are given of all stages of a Bruchid observed in Formosa in seeds of Ambari hemp [*Hibiscus cannabinus*] imported from India. Fumigation for 48 hours with carbon bisulphide at the rate of 4 lb. per 1,000 cu. ft. gave complete mortality of the Bruchid, and only slightly affected the germinating power of the seeds.

MIWA (Y.) & MORIYAMA (T.). **On the Habits and Food of a Coccinellid (*Alesia discolor* Fab.).** [*In Japanese.*]—*Trans. nat. Hist. Soc. Formosa* **30** no. 200–201 pp. 119–125, 2 pls. Taihoku, 1940.

The Coccinellid, *Verania* (*Alesia*) *discolor*, F., has been observed to feed on rice pollen in Formosa, but in experiments it also fed on thrips, Aphids and Psyllids and did not breed successfully when supplied with pollen only. It has up to 5 generations a year, and overwinters chiefly in the adult stage. The adults are present throughout the year, but become inactive at temperatures below 13–14°C. [55·4–57·2°F.] and remain among grasses or in crevices. The egg stage lasts 6–7 days, and the first larvae hatch in mid-May. In summer the larval stage lasts over 3 weeks, and the pupal stage 4–5 days.

TABATA (S.) & TAMANUKI (K.). **On the Hymenopterous Parasites of the Pine Caterpillar, *Dendrolimus sibiricus albolineatus* Mats. in southern Sakhalin.**—[*In Japanese.*]—*Rep. Cent. Exp. Sta. Sakhalin* no. 33 For., pt. 2, 50 pp., 4 col. pls. Konuma, Sakhalin, 1940.

Descriptions are given of 26 parasites of *Dendrolimus albolineatus*, Mats., which is an important pest of pine in Sakhalin, together with notes on the bionomics of some of them. The eggs are parasitised by *Pachyneuron nawai*, Ashm., *Ooencyrtus pinicolus*, Mats., *Telenomus dendrolimusi*, Chu, which sometimes destroys 94 per cent., and *Trichogramma dendrolimi*, Mats., of which 10–30 or more individuals emerge from a single host egg. The adult females of *Telenomus* and *Trichogramma* are carried on the wings of the moths. The parasites of the larvae include *Apanteles ordinarius*, Ratz., *Hypopteromalus apantelophagus*, Crwf., *Hemiteles* spp., *Rhogas dendrolimi*, Mats. (of which *Phanomeris spectabilis*, Mats. [*R.A.E.*, A **14** 426; **20** 653] and *Rhogas metanastriae*, Rohw. [**22** 324] are synonyms), *Phygadeuon* sp., *Cryptus* sp., *Stylocryptus profligator*, F., and *Paniscus testaceus*, Grav. The life-cycle of *Apanteles ordinarius*, which is a gregarious parasite, is not completed in less than 50 days, and it has 2–3 generations a year, overwintering in the larval stage. The rate of parasitism by it is sometimes as high as 85 per cent. The parasites of the pupae include *Trogus lutorius* f. *jezoensis*, Uch., *Amblyteles armatorius*, Först., *Theronia atalantae*, Poda, *Pimpla disparis*, Vier., and *Pimpla instigator*, F.; they are less important than those that attack the eggs and larvae.

TAMANUKI (K.). **The Bark-beetles attacking Spruce in southern Sakhalin.** [*In Japanese.*]—*Publ. Sect. For. Sakhalin,* 64 pp., 14 pls., 17 figs. Konuma, Sakhalin, 1940.

A key is given to the 24 bark-beetles that attack spruce in southern Sakhalin, together with notes on the morphology and bionomics of the more important of them. They almost always occur in association with the fungus, *Ceratostomella piceae,* while *Lenzites sepiaria* and *Polystictus abietinus* have been observed on trees killed by them. *Xyloterus* (*Trypodendron*) *lineatus,* Ol., appears to have not more than two generations a year, although the adults emerge from mines in the wood very early in spring and the development of the immature stages is rapid. The females bore deeply into the wood through crevices in the bark, and 2–4 usually occur in each mine, together with one male. They lay about 20 eggs, and the egg, larval and pupal stages last about 7, 20 and 8 days, respectively. *Dendroctonus micans,* Kug., chiefly infests the basal parts of large stems of vigorous trees. *Hylastes* (*Hylurgops*) *glabratus,* Zett., is restricted to spruce in Sakhalin ; the egg, larval and pupal stages last 25–30, 30 and 10 days, respectively, and the larvae, pupae and adults overwinter. *Polygraphus gracilis,* Niisima, attacks thin-barked trees and also the distal parts of the branches of rough-barked ones. It has one generation a year and hibernates chiefly in the adult stage. *P. proximus,* Bldf., which attacks weakened or fallen trees, also has one generation a year, and the adults appear from late May to early June. Females lay about 50 eggs, which hatch in about 20 days.

KÔNO (H.). **Insect Damage as a Factor affecting the second Blossom of Trees.** [*In Japanese.*]—*Bot. & Zool.* **8** no. 2 pp. 353–364, 7 figs. Tokyo, 1940.

As a result of dry, warm weather in the spring and summer of 1938, outbreaks of several insect pests occurred in Hokkaido. The Notodontid, *Phalera flavescens,* Bremer & Gray, was abundant on cherry and apple, and defoliated many of the trees in August. Many of the defoliated cherry trees blossomed a second time, especially those 7–20 years old, and new leaves appeared from late August to the end of September. This phenomenon also followed defoliation by other pests, including the sawfly, *Caliroa* (*Eriocampoides*) *limacina,* Retz.

YAGO (M.) & FURUICHI (S.). **On the Aphids infesting the Pear Tree, especially** *Toxoptera piricola* **Mats.** [*In Japanese.*]—*J. Plant Prot.* **27** no. 2 pp. 126–130. Tokyo, 1940.

The winter eggs of *Toxoptera piricola,* Mats., are laid on pear, and in Shizuoka Prefecture, they hatch in late March or early April. The apterous fundatrices give rise to both alate and apterous females. The alatae migrate to an unknown summer host, which may be a species of *Cyperus* [*cf. R.A.E.,* A **25** 676], and the pear trees are free from infestation by mid-June. The sexuparae return to them in November, and the winter eggs are laid on small twigs or on the basal parts of the inner sides of fruit buds. Sprays of pyrethrum and soap [*cf.* **26** 604], nicotine sulphate and soap, or derris, applied when the eggs hatch in spring, are recommended for control.

KATSUMATA (K.). **On the Control of the Scolytid,** *Scolytoplatypus daimio* **Blandf. and the Disease,** *Endothia parasitica* **(Murr.) And. et And., of Chestnut.** [*In Japanese.*]—*J. Plant Prot.* **27** no. 3 pp. 194–198. Tokyo, 1940.

Scolytoplatypus daimio, Bldf., is a serious pest of chestnut trees in Ishikawa Prefecture (Japan) and may be a vector of the fungus, *Endothia parasitica*. Almost complete control of the adults of this Scolytid was given by whitewashing the stems up to a height of 3 ft. in April.

KONO (T.). **Experiments with Fumigation with Chloropicrin against Insect Pests of stored Grain.** [*In Japanese.*]—*J. Plant Prot.* **27** no. 4 pp. 276–283. Tokyo, 1940.

Plodia interpunctella, Hb., *Aphomia gularis*, Zell., and *Ephestia cautella*, Wlk., are the most important of the moths that infest stored grain in Japan. *Plodia* is the most injurious, but is easily destroyed by fumigation with chloropicrin. In experiments in which this fumigant was used at rates of 1 and 0·5 lb. per 1,000 cu. ft. and at a constant temperature of 30°C. [86°F.], all stages were killed by exposure for 30 minutes and 1 hour, respectively. The pupae are the most resistant and the adults the least, while the larvae are more resistant than the eggs.

OZAKI (S.). **Results of Experiments of hastening the Adult Emergence in** *Chilo simplex* **Butl. in the First Emergence Period.** [*In Japanese.*]—*J. Plant Prot.* **27** nos. 6 & 7 pp. 410–418, 470–477. Tokyo, 1940.

In Aichi Prefecture (Japan), the adults of the overwintered generation of *Chilo simplex*, Btlr., usually emerge in numbers in the second half of June at the time when the rice seedlings are planted out in the fields. They oviposit on the seedlings, which consequently suffer severe damage. The larvae hibernate in rice stalks heaped in the field or stored in houses, and the time they require to complete their metamorphosis depends on the temperature to which they are exposed. The moths consequently emerge later from stalks in the shaded part of a heap than from those exposed to the sun and later still from stalks in houses.

UTSU (T.). **On the Relation of** *Cylas formicarius* **Fab. to the Disease of Sweet Potato.** [*In Japanese.*]—*J. Plant Prot.* **27** no. 7 pp. 477–484. Tokyo, 1940.

In Amami-Oshima (Loochoo Islands), infestation of sweet potato tubers by *Endoconidiophora fimbriata* is much more severe if they are also infested by *Cylas formicarius*, F. The fungus enters the tubers through the wounds made by the weevil, is carried by it, and is apparently able to survive passage through its alimentary canal.

OISHI (T.). *Sideridis unipuncta* **Haw. and its Enemies.** [*In Japanese.*] —*J. Plant Prot.* **27** no. 7 pp. 488–490. Tokyo, 1940.

In October 1939, considerable injury was caused to Italian millet [*Setaria italica*] in Fukushima by *Cirphis* (*Sideridis*) *unipuncta*, Haw.

The larvae of this Noctuid were parasitised by *Ichneumon* (*Melanichneumon*) *irritator*, F. Smith, and the Tachinid, *Neopales* (*Pales*) *pavida*, Mg. The latter is also a parasite of the silkworm [*Bombyx mori*, L.].

Sakai (K.). **Biology and Control Methods of Autumn Leaf-hoppers.** [*In Japanese.*]—*J. Plant Prot.* **27** no. 10 pp. 694–702. Tokyo, 1940.

In 1940, *Sogata furcifera*, Horv., and *Nilaparvata oryzae*, Mats., occurred in large numbers on rice in Kyushu after mid-July, the latter being the more injurious. These two Delphacids appear in rice nurseries suddenly in June in Kagoshima Prefecture; the former increases in numbers at temperatures of over 30°C. [86°F.] in summer, but becomes less numerous in September, while the latter increases in September and October, especially in wet weather with day temperatures of about 25°C. [77°F.]. The control measures generally adopted in Japan are discussed [*cf. R.A.E.*, A **24** 63].

Saito (H.). **The Effect of spraying Insecticides in the Blossoming Season of *Citrus* and its Value in preventing Injuries by anthophilous Scarabaeidae.** [*In Japanese.*]—*J. Plant Prot.* **27** no. 10 pp. 705–714. Tokyo, 1940.

Some Lamellicorn beetles visit the flowers of *Citrus* in Japan and injure the young fruits. They can be repelled by spraying with lead arsenate, lime-sulphur and Bordeaux mixture, but emulsions of lubricating oil cause the flowers to fall.

Okada (I.) & Oike (K.). **Life History of *Phanerotoma planifrons* Nees, a Parasite of *Grapholitha glycinivorella* Mats. (Preliminary Report).** [*In Japanese.*]—*Ōyō-Kontyū* **2** no. 4 pp. 137–147, 5 figs., 10 refs. Tokyo, 1940.

Cydia (*Grapholitha*) *glycinivorella*, Mats., which is very injurious to soy beans, is the only known host of the Braconid, *Phanerotoma planifrons*, Nees, in Manchuria, where both have one generation a year. The parasite larvae emerge from those of the host in July and feed externally on the body fluids. The prepupal and pupal stages last 1–2 and about 8 days, and the adults emerge in late July and the first half of August. The eggs are laid in the host eggs on the pods. When fed on sugar solution, the males lived for about a fortnight and the females, which are much more numerous, for about three weeks.

Okazaki (K.). **On the Bionomics of *Agromyza oryzella* Matsumura and Laboratory Tests of some Insecticides against it.** [*In Japanese.*]—*Ōyō-Kontyū* **2** no. 4 pp. 148–161, 3 figs., 12 refs. Tokyo, 1940.

In Yamagata Prefecture, northern Honshu, the adults of *Agromyza oryzella*, Mats., emerge in May and oviposit on rice seedlings and *Zizania latifolia*. The longevity of the males is about 6 days, and that of the females about 16·5 days in the overwintered generation and 8 in the summer one. The females feed on the fluids that exude from wounds made by the ovipositor in the leaves; the total numbers of eggs laid by those of the overwintered and summer generations are about 180 and 60. They hatch in an average of 5·6 days in spring and

3·4 in summer. The larvae mine the leaves for about 7–9 days and then pupate on them. First-generation pupae give rise to adults after an average of 8·7 days, but most of those of the second generation hibernate. Adults confined with rice seedlings sprayed with calcium arsenate died in 4 days, and the females deposited only 60 per cent. of the normal number of eggs. Sprays of nicotine sulphate were tested at concentrations of 1 : 800 and 1 : 1,000. The stronger spray killed all the eggs and over 90 per cent. of the larvae, while the weaker one and a derris spray both gave over 90 per cent. mortality of adults and larvae. Pyrethrum was also effective against the eggs and larvae.

YASHIRO (H.). **Baits for attracting** *Dacus cucurbitae.* [*In Japanese.*] —*Ōyō-Kontyū* **2** no. 4 pp. 162–165, 4 refs. Tokyo, 1940.

In view of the injury caused to cucurbits by *Dacus cucurbitae*, Coq., in Ishigaki (one of the Loochoo Islands), the Braconid parasite, *Opius fletcheri*, Silv., was introduced from Formosa, but the low winter temperatures in Ishigaki are apparently unsuited to it, and the Trypetid has not decreased in numbers. Effective baits for the adults of the latter are mixtures of honey and water (1 : 20) or wine, brown sugar and water (1 : 2 : 40). Both baits attract more females than males.

KAWADA (A.) & SUENAGA (H.). **On the Chestnut-Bark Miner,** *Acrocercops* **sp.** [*In Japanese.*]—*Ōyō-Kontyū* **2** no. 5 pp. 192–201, 2 pls., 2 figs. Tokyo, 1940.

Chestnut, willow, pear, *Rhus* and oak are attacked in Japan by bark-miners of the genus *Acrocercops* that are identical in the morphology of all stages. The species infesting chestnut is very injurious in Saitama Prefecture, and an account is given of its bionomics [*cf. R.A.E.*, A **26** 669]. The life-histories of those in willow, oak and *Rhus* are similar, but that of the pear bark-miner is quite different.

KOYAMA (T.). **Notes on the Corn Borer,** *Pyrausta nubilalis* **Hübner, in Akita Prefecture.** [*In Japanese.*]—*Ōyō-Kontyū* **2** no. 5 pp. 202–212, 6 figs. Tokyo, 1940.

Pyrausta nubilalis, Hb., damages more than 50 per cent. of the ears of maize in Akita Prefecture, northern Honshu, where it has two generations a year. Of overwintered larvae found in maize stalks in heaps in the field, many were in the upper parts of the heaps, and more occurred just beneath the skin of the stalks than in the pith. There were sometimes as many as five larvae in a stalk, but usually not more than one. The larvae began to pupate in mid-May, most of them doing so in early June, and the adults emerged from early June to the beginning of July. Pupation of the first-generation larvae occurs during August.

NAREMATSU (I.) & KAKIZAKI (T.). *Eriophyes* **sp., a serious Pest of** *Juniperus procumbens* **and its Control Measures.** [*In Japanese.*]—*Ōyō-Kontyū* **2** no. 5 pp. 213–218, 2 figs. Tokyo, 1940.

The terminals of *Juniperus procumbens* in gardens in Tokyo Prefecture are attacked by a mite of the genus *Eriophyes*. The overwintered

adults begin to oviposit in late April or May. The control measures recommended are removing the infested parts in winter and spraying with a mixture of lime-sulphur and nicotine sulphate.

ENDO (K.). **Outbreaks of *Agrotis ypsilon* Rottenb. in Sakhalin in 1939.** [*In Japanese.*]—*Ōyō-Kontyū* **2** no. 5 pp. 219–221. Tokyo, 1940.

Agrotis ypsilon, Hfn., was very injurious to sugar-beet in Sakhalin in 1939. The larvae were killed by poison baits of 100 lb. rice bran, 1½ lb. calcium arsenate, 2 lb. brown sugar and enough water to moisten.

OHTA (Y.). **Studies concerning *Macrosiphum granarium* Kirby.** [*In Japanese.*]—*Insect World* **44** nos. 3–6 pp. 71–76, 103–106, 138–141, 167–169. Gifu, 1940.

Descriptions are given of all the forms of *Macrosiphum avenae*, F. (*granarium*, Kby.), which attacks wheat, rice, Italian millet [*Setaria italica*] and other graminaceous plants and has 35–37 generations a year near Gifu. The sexual forms appear on wheat in October, and the eggs are laid from mid-November to early January and hatch in late March. The Aphids increase in numbers from late April or early May, become abundant on wheat from mid-June, and decrease from September; they are scarce in November and December. The average vivipara lived for 37·8 days, produced 63·4 offspring during 25·8 days, and died 1·5 days after reproduction had ceased. The young are produced at any time, but mostly during the day.

KAWASAKI (M.). **Some Observations on the Life after the Fall Migration to the Peach Tree in *Myzus persicae* Sulz. in Manchuria.** [*In Japanese.*]—*Insect World* **44** nos. 4 & 5 pp. 101–103, 132–135. Gifu, 1940.

Observations on *Myzus persicae*, Sulz., in Manchuria showed that the gynoparae begin to migrate to peach from summer food-plants in early October, while the winged males occur on the peach trees from late October until late November. The gynoparae survive on peach for up to 11 days (average 5 days), and the numbers of sexual females they produce average 5 and range up to 12. Almost all the sexual females migrate from the leaves to the buds before becoming adult; pairing occurs from late October on the branches near the buds, and sometimes on the stems, but hardly ever on the leaves. So far as could be ascertained, the sexual female lays only one egg; the eggs hatch in mid-March.

OHTA (Y.). **On *Dichomeris oceanis* Meyrick.** [*In Japanese.*]—*Insect World* **44** nos. 9 & 10 pp. 263–265, 294–297. Gifu, 1940.

Dichomeris oceanis, Meyr., all stages of which are described, has three generations a year in Japan, the adults emerging from late May to early June, in late July and in early August. The larvae feed on cabbage, *Wistaria* and *Lithocarpus* (*Pasania*), and those of the overwintering generation hibernate from late October to late April and pupate in rolled or spun leaves in May.

KUWANA (Z.), ISHII (G.) & KUROSAWA (T.). **Studies on the Hymenopterous Parasites of *Margaronia pyloalis* Walk. 1. External Morphology and Ecology of *Exeristes roborator* Fab.** [*In Japanese.*]—*Bull. Imp. seric. Exp. Sta.* **9** no. 8 pp. 469–494, 12 pls., 6 figs. Tokyo, 1939. (With a Summary in English.) [Recd. 1941.]

Descriptions are given of all stages of the Ichneumonid, *Pimpla* (*Exeristes*) *roborator*, F., which is an external parasite of the larvae of *Margaronia pyloalis*, Wlk., on mulberry in Japan. Near Tokyo, it generally has 5 generations a year, the adults occurring from April to November. The full-grown larvae of the last generation hibernate and pupate in March. Adults fed on sugar solution survived for 20–30 days; in nature they feed on larvae of the host. The females prefer full-fed larvae for oviposition and deposit their eggs about 10 days after pairing on the bodies of the larvae or on the leaves near them. A single female lays 10–80 eggs (usually 20–50) and generally attacks 30–70 hosts, though oviposition does not necessarily follow. The eggs hatch in 1–4 days, and the larval stage is completed in 4–19 days in summer and spring, averaging 16·4 and 10·1 days at 15 and 20°C. [59 and 68°F.], respectively. Only one larva completes development on a single host. The pupal stage lasts 3–26 days.

ESAKI (T.) & SAMESHIMA (T.). **Report on the Leaf-hoppers injurious to the Rice Plant and their Natural Enemies, no. 11 (for the Year 1939).** [*In Japanese.*]—42 pp., 1 pl., 4 figs. Fukuoka, Dep. Agric., Kyushu Imp. Univ., 1940.

Jassids and Delphacids were less common on rice in 1939 than in previous years [*cf. R.A.E.*, A **27** 362]; the numbers taken at a light-trap at Oita, Kyushu, are shown in graphs. There was a sharp rise in the numbers of *Deltocephalus dorsalis*, Motsch., in June and again in early September, while *Nephotettix bipunctatus cincticeps*, Uhl., was abundant in mid-June, early August and early September. The egg stage in *Nephotettix* lasted 7–10 days at a constant temperature of 25°C. [77°F.], and 67·4 per cent. of the eggs hatched. The duration of the nymphal stage averaged 17·4 days at 25°C. and 13·3 at 30°C. [86°F.] and was a little longer in the females than in the males. Hatching occurs during the day. In *Nilaparvata oryzae*, Mats., the egg stage lasted 7–10 and 6–10 days and the nymphal stage averaged 14·8 and 20·1 at 25 and 30°C., respectively. Eggs of *Deltocephalus* survived the winter in leaves kept at 100 per cent. relative humidity, but those of *Sogata furcifera*, Horv., and *N. oryzae* perished. Adults and nymphs of *Deltocephalus* and *Nilaparvata* are apparently unable to overwinter near rice-fields round Fukuoka.

The Dryinid, *Echthrodelphax bicolor*, Esaki & Hashimoto, all stages of which are described and which parasitises *N. oryzae* [*cf.* **24** 465], has 4 or 5 generations a year in captivity and overwinters in the larval stage in cocoons on the leaves. Some of the adult females survived for over 2 weeks; they oviposit in the thorax or under the wing pads of the hosts, and larval sacs are formed on the bodies of the latter 3·8 days on an average after oviposition. More than one parasite was seldom observed on a single host, and even when more than one occurred, only one gave rise to an adult.

Sakai (K.), Haruta (D.) & Ikeda (Y.). **Studies on the Biology and Control of** *Aonidiella aurantii* **Mask.** [*In Japanese.*]—*Spec. Rep. Kagoshima agric. Exp. Sta.* no. 1 pp. 1–145, 10 pls., 18 figs. Kagoshima, 1940.

Aonidiella aurantii, Mask., all stages of which are described, is a serious pest of *Citrus* in Kagoshima Prefecture, especially in the coastal districts, and also infests a number of other plants, including *Cycas*, *Yucca*, *Sterculia* (*Firmiana*) *platanifolia* and *Elaeagnus* [*cf. R.A.E.*, A **26** 604]. Its rate of development varies greatly with temperature and it may have from one to four generations a year, the usual number being two [*cf.* **27** 207]. On *Citrus*, the males are commoner on the upper surfaces of the leaves and the females on the lower. The males survive for 4–6 days after emergence, and both sexes pair several times. Females live for up to 168 days. Reproduction does not occur from January to April and is never parthenogenetic. Data on the migration of the crawlers are given; they can survive for about 24 hours before settling. Allied species of *Aonidiella* are described.

Natural enemies of this Coccid include the Chalcidoid parasites, *Aphytis* (*Aphelinus*) *chrysomphali*, Merc., and *Aspidiotiphagus citrinus*, Craw, a fungus of the genus *Fusarium*, and the predacious Coccinellid, *Chilocorus kuwanae*, Silv. It is very effectively controlled by fumigation with hydrocyanic acid gas, especially in summer, while fair control is given by spraying with lubricating oil emulsion (2·5–3 per cent. actual oil); spraying with a resin wash in summer is also recommended.

Kiyoku (M.). **On the Life History and Habits of** *Glyphodes pryeri* **Butl.** [*In Japanese.*]—*Trans. Kansai ent. Soc.* **9** pt. 2 pp. 43–65, 1 pl., 3 figs. Kyoto, 1939. [Recd. 1941.]

The morphology and bionomics of *Margaronia* (*Glyphodes*) *pryeri*, Btlr., which attacks mulberry in Japan, are described and compared with those of another mulberry Pyralid, *M.* (*G.*) *pyloalis*, Wlk. Near Kyoto, *M. pryeri* has 4 generations a year; the full-fed larvae begin to hibernate in late October at a temperature of about 18°C. [64·4°F.] or below, and pupate in late April or May, most doing so in mid-May at about 16°C. [60·8°F.]. The adults emerge at night from mid-May to mid-June. Larvae that have not completed their development are apparently unable to survive the winter. Adults fed on a sugar solution lived for about a fortnight, and females deposited approximately 150 eggs on the leaves in less than a week. The larvae hatched in 3·5–9 days and fed on the leaves. The larval and pupal stages lasted 15–33 and 8–20 days, respectively, according to temperature.

Abe (T.). **Effect of relative Humidity on the Eggs of** *Plodia interpunctella* **Hübn.** [*In Japanese.*]—*Trans. Kansai ent. Soc.* **9** pt. 2 pp. 66–73. Kyoto, 1939. [Recd. 1941.]

An account is given of experiments on the effect of atmospheric humidity on the eggs of *Plodia interpunctella*, Hb., which is a pest of stored rice in Japan. They were carried out at 26°C. [78·8°F.] and showed that the optimum relative humidity for hatching is 57–91 per cent. The percentages of eggs that hatched at humidities of 91 and 31 per cent. were 95·37 and 77·21, respectively.

YASHIRO (H.). **On the Life-history of** *Stromatium longicorne* **Newm.** [*In Japanese.*]—*Bull. Okinawa For. Soc.* no. 1 pp. 1–10, 2 pls. Naha, 1940.

The Cerambycid, *Stromatium longicorne*, Newm., all stages of which are described, is common in the Loochoo Islands, where it attacks furniture and structural timber in houses. The damage is most serious in seasoned timber, and in some kinds of wood is almost confined to it. The adults, which appear in late June and are commonest in July and August, appear not to feed; they usually pair at night and remain motionless during the day. The eggs are laid in crevices in the wood at night, mostly in July and August, and hatch in 8–12 days; the numbers of eggs laid by two females under observation were 108 and 287. The larvae require nearly two, or occasionally three, years to complete their development and pupate in April or May.

NAKAYAMA (S.). **On the Biology and Control of** *Epilachna vigintioctomaculata* **Motsch.** [*In Japanese.*]—*Rep. agric. Exp. Sta. Korea* **11** no. 2–3 pp. 91–112, 3 pls., 1 map, 8 figs. Suigen, 1940.

Epilachna vigintioctomaculata, Motsch., all stages of which are described, is widely distributed in Korea, where it feeds on many plants, including potato, which is preferred [*cf. R.A.E.*, A **27** 362]. It is numerous and causes serious injury in the northern districts, in which potato is much cultivated. Near Suigen it often has 3 generations a year. The overwintered adults begin to feed in May, survive until July or August, and lay more eggs than those of the summer generations. The eggs are deposited in batches of up to 18, usually on the lower surfaces of the leaves, and the egg, larval and pupal stages last 3–11, 14–26 and 5–10 days, respectively. The larvae are parasitised by the Eulophid, *Pleurotropis simiolus*, Gir. A spray of lead arsenate is very effective for control.

KAYASHIMA (I.). **Notes on a Weevil (***Pachyrrhynchus moniliferus* **Germ.) injurious to Cacao Fruit in the Philippine Islands.** [*In Japanese.*]—*Trans. nat. Hist. Soc. Formosa* **30** no. 200–201 pp. 126–129, 1 pl. Taihoku, 1940.

Cacao fruits imported from the Philippine Islands into Formosa have been found heavily infested by the weevil, *Pachyrrhynchus moniliferus*, Germ., the larva, pupa and adult of which are briefly described.

MITONO (T.). **A Longicorn Beetle destructive to Balsa Tree.** [*In Japanese.*]—*Taiwan no Sanrin* no. 162 pp. 1–8, 3 figs. Taihoku, 1939. [Recd. 1941.]

Larvae of *Pachyosa perplexa*, Pasc., which is widely distributed in Formosa and is known to be a pest of *Citrus*, have recently been observed to infest balsa [*Ochroma pyramidale*] in the southern part of the Island. The adult and larva of this Lamiid are described, and its synonymy is discussed.

MITONO (T.). **Insect Pests boring into the Stems of** *Pinus*. [*In Japanese.*]—*Taiwan no Sanrin* no. 165 pp. 21–26, 2 pls. Taihoku, 1940.

A description is given of the adult of the weevil, *Sipalus formosanus*, Kôno, the larvae of which bore in the stems of weakened or fallen pines (*Pinus taiwanensis* and *P. massoniana*) in Formosa.

MITONO (T.). **Insect Pests feeding on the Leaves of Balsa.** [*In Japanese.*]—*Taiwan no Sanrin* no. 166 pp. 11–18, 1 fig. Taihoku, 1940.

The larvae of *Sylepta derogata*, F., were observed feeding on the leaves of balsa [*Ochroma pyramidale*] in Formosa. All stages of this Pyralid are briefly described, and references to it in the literature are noticed.

KOIDZUMI (K.). **Experimental Studies on the Influence of low Temperatures upon the Development of Fruit Flies (12th Report). On the Acclimatisation to low Temperatures of the Pupae of** *Chaetodacus dorsalis* **Hendel.** [*In Japanese.*]—*J. Soc. trop. Agric. Formosa* **12** no. 1 pp. 48–53. Taihoku, 1940.

The technique of these investigations in Formosa on the acclimatisation to low temperatures of newly formed pupae of *Dacus* (*Chaetodacus*) *ferrugineus dorsalis*, Hend., was similar to that used in the case of *D.* (*C.*) *cucurbitae*, Coq. [*R.A.E.*, A **26** 517]. Pupae exposed to intermediate temperatures were again more resistant to cold than those subjected to it suddenly, but the power of acclimatisation was less than in *D. cucurbitae* and did not vary with the season.

KOIDZUMI (K.) & KUBOTA (K.). **Notes on the Autecology of some Fruit Flies. Effects of Temperature and Soil Moisture on the Adult Emergence of** *Chaetodacus ferrugineus dorsalis* **Hendel.** [*In Japanese.*]—*J. Soc. trop. Agric. Formosa* **12** no. 2 pp. 96–98. Taihoku, 1940.

Investigations in Formosa showed that the thermal limits for the emergence of adults of *Dacus* (*Chaetodacus*) *ferrugineus dorsalis*, Hend., are 11 and 36°C. [51·8 and 96·8°F.], but emergence is restricted below 18 and above 34°C. [64·4 and 93·2°F.]. The pupae are less resistant to low temperatures than those of *D.* (*C.*) *cucurbitae*, Coq. [*cf.* preceding abstract]. The percentage of emergence was highest in sandy soil containing 2 per cent. water and decreased as the water-content increased; very little emergence occurred in soil containing less than 2 per cent.

TAKAHASHI (H.). **Outbreak of** *Phaenacantha marcida* **Horv. and its Control.** [*In Japanese.*]—*J. Sug. Plant. Ass. Formosa* **18** no. 6 pp. 203–241, 7 pls. Tainan, 1940.

Phaenacantha marcida, Horv., which is indigenous in Formosa and probably feeds normally on *Miscanthus*, caused serious injury to sugar-cane in the north-eastern part of the Island in 1938 and 1939. All stages of this Colobathristid are described. The outbreak was not detected until November 1938, when the lower leaves of the canes had turned yellowish, and up to 250 adults were observed on each old

leaf sheath. The apical halves of infested leaves usually bend downwards, but show no marks of attack, and the average sucrose content of juice from infested canes was reduced. The outbreak is attributed to high temperature in April, low rainfall in May and June, and the fact that the fields are not burned over after harvest. The bug has 3 generations a year, the adults of which appear in June, August and October. Those of the third generation hibernate, migrate in March to young cane, on which they pair and oviposit, and die by June. The eggs are laid singly in the dead leaves of young canes and in the living leaves of mature ones, chiefly on the lower surfaces. The egg and nymphal stages last about 16 and 40 days, respectively, in spring, and the adults survive for over 3 months in summer. Excellent control of the adults is given by a spray of nicotine sulphate, while one containing a proprietary preparation of derris and soap is slightly less effective. Natural enemies comprise an unidentified Eupelmid, which parasitised up to 53·3 per cent. of the eggs, and the spider, *Clubiona jucanda*, Karsch, and the ant, *Pheidole javana* var. *dolenda*, Forel, which destroy the adults and nymphs.

SCHNEIDER (F.). **Schadinsekten und ihre Bekämpfung in ostindischen Gambirkulturen.** [Injurious Insects and their Control in East Indian Gambier Plantations.]—*Mitt. schweiz. ent. Ges.* **18** pt. 3, repr. 131 pp., 42 figs., 8 refs. Berne, 1940.

This paper is based on observations in two plantations of gambier (*Uncaria gambir*) in Sumatra in 1934–37. The topography and climate of the areas concerned and the technique of gambier cultivation are described, and brief notes are given on the numerous insects observed on the plants (including parasites and predators as well as phytophagous species), many of them being unidentified. Only two cause appreciable injury; they are the Drepanid, *Oreta carnea*, Btlr., and the Pyralid, *Margaronia marinata*, F., both of which are indigenous in the primeval forest. The others include the Aegeriid, *Sura uncariae*, sp. n., which is described from adults of both sexes and of which the larvae bore in the stems.

Some of the observations on *Oreta* have already been noticed [*R.A.E.*, A **27** 385]. The egg, larval and pupal stages and the preoviposition period last 5, 22, 8 and 2 days, respectively. Rain favours infestation, but the nature of the soil is also important, since more injury is done to plants on wet and badly drained ground or in depressions with a deep clay subsoil than to those on dry ground. Weak plants are more infested than vigorous ones, and plants 3–5 months old more than those 8–10 months old. Natural enemies include the Scelionid egg parasite, *Telenomus ochus*, Nixon, the Chalcid pupal parasite, *Brachymeria euploeae*, Westw., and the Pentatomid previously recorded as *Cantheconidea acuta*, Vollen. [**27** 386], but here named *C. gaugleri*, sp. n. All stages of this bug and its bionomics are described. Development lasts about a month, and both nymphs and adults are predacious on the larvae of a number of Lepidoptera, but it becomes sufficiently abundant to exercise noticeable control on *O. carnea* only if the gambier plants are of high growth and continuously and heavily infested.

Adults of *T. ochus* pair immediately after emergence, and the females oviposit 2–3 days later. Development is completed in 11 days, and males and females occur in equal numbers. The percentage of eggs

parasitised by the Scelionid is usually less than 15. Percentages of 2–5 are not exceeded in heavy infestations of *O. carnea* if the generations of the host are well separated, since the parasite develops three times as fast as *Oreta* and has difficulty in surviving the periods when eggs are scarce. If development of the host is continuous, from 50 to over 70 per cent. of the eggs may be parasitised. Observations on *B. euploeae* have already been noticed [*loc. cit.*]. It is polyphagous, and its other hosts in the gambier plantations include *M. marinata*. The egg, mature larva and female are described. A female may lay more than one egg in large pupae, but seldom does so in a pupa of *Oreta* and never in that of *Margaronia*. The larva hatches 36 hours after oviposition and develops in the host pupa, giving rise to an adult after 12–13 days. Bacteria introduced in the act of oviposition infect the host, and the larva feeds on the decomposing tissues. The developing larvae are themselves sometimes affected by the bacteria, and considerable mortality then occurs. The process of pairing and oviposition are described. In nature, *O. carnea* and *M. marinata* were about equally parasitised. *O. carnea* pupates in a tightly rolled leaf through which *B. euploeae* passes its ovipositor, but *M. marinata* pupates in the middle of a chamber formed by a folded leaf to which the Chalcid must first gain access by cutting an entrance hole.

Descriptions are given of all stages of *M. marinata* and the internal organs of the female. The egg, larval, prepupal and pupal stages last 5, 22, 2 and 9 days. The eggs are usually laid singly between the sepals of the flower buds of the capitulum, and the larvae feed on the buds, destroying the ovaries and causing the buds to dry up. In the fourth or fifth instar, they attack the leaves, which they fold and spin together, migrating from one leaf to another. The leaves turn brown and eventually drop. Pupation occurs in both dead and living leaves, but 52 per cent. of the moths emerging from pupae in green leaves were females, while pupae in dry leaves were slightly shorter and only 21 per cent. of the moths from them were females. Oviposition begins about 9 days after emergence and lasts about a fortnight. Continued collection of the larvae at regular intervals is the most effective measure against *M. marinata*, but was not sufficient to prevent an outbreak of *O. carnea*, against which sprays of lead arsenate should be applied [*loc. cit.*].

COTTERELL (G. S.). **Citrus Fruit-piercing Moths—Summary of Information and Progress.**—*Pap. 3rd W. Afr. agric. Conf. Nigeria June 1938 Sect. Gold Coast* **1** pp. 11–24, 5 pls. Lagos [1940].

A list based on observations at Aburi (Eastern Province) and Asuansi (Central Province) is given of 27 species of Noctuids of which the adults pierce the fruits of sweet varieties of *Citrus* in the Gold Coast Colony, showing the months in which they have been observed attacking *Citrus* and other fruits and those in which they have been present but have not attacked fruits. The most harmful are species of *Othreis* and *Achaea*; *Anomis* spp. and *Dermaleipa* spp. are less important, and the rest are casual visitors that are probably attracted to fruits that are already pierced. The most harmful species of all is *Othreis fullonia*, Cl. (*fullonica*, L.), while the most important species of *Achaea* are *A. lienardi*, Boisd., *A. faber*, Holl., *A. ezea*, Cram., and *A. catocaloides*, Gn. The *Citrus* fruits attacked, in

descending order of preference, are tangerine orange, orange, grape-fruit and sour orange, while other fruits pierced are mango, guava, cashew [*Anacardium occidentale*], banana and *Averrhoa*. The succulent growths of *Opuntia* are also punctured on the coastal plains. Lemon and lime are not attacked. Records for 1931–37, inclusive, show that *O. fullonia* and *A. lienardi* are the most abundant species, the former being the more important as it also attacks immature fruits and makes larger punctures. It attacks *Citrus* from the end of March, becomes abundant in April or early May, when the fruits begin to mature, and occasionally recurs on a small scale during the second cropping season between September and January. *Achaea* spp. attack the fruits from about mid-April until the end of June, by which time all the fruits have either dropped or have been harvested. They are scarce from July to March, although suitable fruits are available.

A list is given of the plants on which larvae of some of the moths have been found. The four principal species of *Achaea* occur on *Phyllanthus discoideus*, and *A. lienardi* also on other plants. *O. fullonia* has been observed only on *Tiliacora* [*cf. R.A.E.*, A **25** 254], but larvae of *Othreis* have only occasionally been found. The egg, larval and pupal stages of *A. lienardi* were observed to last 4, 21–31 and 14–18 days, respectively.

A survey of the loss of crop of all varieties of budded sweet *Citrus* at Aburi and Asuansi during 1933–37 showed that although the first crop may be reduced by over 90 per cent., loss of crop over the year is very much lower, depending on the proportion of total crop present during the months when the moths are abundant. The loss is chiefly due to *Othreis* [*cf.* **29** 16]. Experiments with grape-fruit showed that punctured fruits drop owing to infection with micro-organisms, chiefly *Oospora citri-aurantii* and *Penicillium digitatum*, and is not due to mechanical injury. Fruits infected with *Oospora* either drop about 15 days after puncture, or remain on the trees but become inedible. Those infected with *Penicillium* usually drop about 4½ days after puncture. Fruits punctured some weeks before maturity frequently do not become infected, as the wounds are rapidly covered by a corky tissue.

Control of the larvae by artificial means is impracticable, owing to their wide range of food-plants and the scattered nature of the latter in the surrounding bush. No effective natural enemies have been observed. Loss of crop could be avoided to a great extent by cultivating varieties of *Citrus* that do not produce their major crop during April–June; thus, budded *Citrus* tends to produce the bulk of its crop in the latter part of the year, whereas seedling *Citrus* chiefly fruits when the moths are abundant. Other measures are early harvesting and storage, provided that this is done not more than 2–3 weeks prior to maturity [*cf.* **29** 16], and the daily collection of windfalls during the period when the moths are abundant. Mango and *Averrhoa* should not be grown near *Citrus*. The effect of poison baits on loss of crop has so far been negligible, chiefly owing to the high incidence of *Othreis* spp., which have rarely been caught in them, and the proximity of unbaited plots of *Citrus*. In experiments, the best results were given by a bait of diluted sugar-cane syrup and sodium arsenite, to which cut *Citrus* fruits were added, but it was necessary to change the solutions weekly owing to fermentation.

KEARNS (H. G. H.) & MARTIN (H.). **The Control of Fruit Tree Red Spider Mite.**—*Rep. agric. hort. Res. Sta. Bristol 1939* pp. 60–65, 4 refs. Bristol [1940].

Since the introduction and general use in England of sprays containing tar distillates led to changes in the spring spray programme, *Paratetranychus pilosus*, C. & F. (*Oligonychus ulmi*, auct.) has become a major pest of fruit trees [*cf. R.A.E.*, A **17** 500, 501], particularly apple and plum. Successive yearly infestations reduce the vigour of the trees, and the cumulative effects are of far-reaching importance. Variations of summer weather have no apparent influence on the degree of infestation, since severe attacks occur in both wet and dry seasons. Following the reduction of the widespread attacks on apple by Capsids prevalent ten years ago and the subsequent discontinuance of the expensive petroleum washes, the spray of nicotine and lime-sulphur applied at petal fall for the control of scab and the apple sawfly [*Hoplocampa testudinea*, Klug] has been relied upon to control the mite, but as this spray is applied primarily to the flower trusses, and in most cases does not wet the lower surfaces of the leaves sufficiently, increasing infestations of *P. pilosus* have resulted.

Two main generation of the mite occur each year. The overwintering eggs are laid in large numbers on second-year and older wood of apple in late July and August, usually in the forks of the shoots. Hatching occurs from the second week in April to the end of May, but usually reaches a peak in the first ten days of May. The mites congregate in large numbers on the small leaves of the blossom trusses, and feed on them for about a week. As the cell sap becomes exhausted, they slowly wander to new feeding places fairly near the original ones. By petal fall of the mid-season varieties, a few adults may be present, but most of them appear about ten days later, when they wander, lay eggs on the lower surfaces of the leaves and die. The eggs hatch within a fortnight, and the resulting mites are fully developed by the end of July. It is this generation that causes serious loss of sap from the foliage at a period when it is urgently required by the tree. In some seasons mites persist in large numbers until the end of September.

P. pilosus can be controlled by killing either the winter eggs or the spring brood of mites before they have laid the summer eggs. The winter eggs are killed by emulsions of petroleum oil containing not less than 3 per cent. actual oil, but it is generally advisable to increase the concentration to 5 per cent. as this also destroys the eggs of Capsids and the winter moth [*Operophtera brumata*, L.]. An emulsion containing 5 per cent. petroleum oil (conforming to the grade E specification as given in a paper already noticed [**23** 497]) is effective if used alone or in combination with 3 per cent. grade A tar oil, 0·1 per cent. dinitro-ortho-cresol, 0·4 per cent. dodecyl thiocyanate (lauryl rhodanate), or 0·225 per cent. butyl carbitol thiocyanate (β-butoxy-β′-thiocyanodiethyl ether). On apples, the emulsions usually provide a high control of the eggs if applied from mid-December until just before the eggs hatch in early April, the most certain results being obtained from sprays applied just before and after bud burst. The emulsion of oil alone is best used just before bud burst, while those containing the other insecticides should be applied up to two weeks before bud burst, about mid-March in average seasons. In plum plantations in which the plum sawfly [*Hoplocampa flava*, L.] is not an important pest, the application of a special post-blossom spray against *P. pilosus* can be

avoided by the use of a winter spray, applied not later than the end of January, of petroleum oil and either dinitro-cresol or thiocyanate, at the concentrations recommended for apple. Drenching applications of the winter sprays must be given, so that the wood is completely covered, and spraying should be carried out under weather conditions that ensure the rapid drying of the spray on the bark.

In its active stages, the mite is readily killed by lime-sulphur, materials containing rotenone, and petroleum-oil contact sprays. The summer eggs and moulting nymphs are not killed by lime-sulphur, derris or *Lonchocarpus*, while many of the summer eggs survive applications of petroleum oils at concentrations safe to foliage (not more than 0·67 per cent. actual oil). On apples after petal fall, the spray must penetrate the leaf hairs that protect the mites and wet the lower surfaces of the leaves completely. On varieties of apple resistant to sulphur, the mites can be controlled by a petal-fall spray containing 8 oz. nicotine (95–98 per cent.), 1–1½ gals. lime-sulphur and a spreader, in 100 gals. water and applied at petal fall, and on others by one of 8 oz. nicotine and 1 gal. petroleum-oil emulsion (0·67 gal. grade G oil) in 100 gals. In the absence of *H. flava*, plums should be sprayed when the "cots" have split for two-thirds of their length with 1 per cent. lime-sulphur and a spreader, but where the sawfly is also a pest, a spray containing 0·67 per cent. grade G oil and sufficient material to give 0·004 per cent. crystalline rotenone [*cf.* **26** 708] should be used.

WALTON (C. L.). **Field Trials for the Control of the Cabbage Root Fly, 1937-39.**—*Rep. agric. hort. Res. Sta. Bristol 1939* pp. 66–71, 3 refs. Bristol [1940].

A brief account is given of the bionomics of *Hylemyia* (*Delia*) *brassicae*, Bch., in England and the injury it causes to cruciferous vegetables [*cf. R.A.E.*, A **15** 648]. Attack is usually sporadic and may affect over 50 per cent. of a total crop. Since work on the control of the larvae has shown that mercurous chloride (calomel) is safer for use than mercury bichloride (corrosive sublimate) [*cf.* **25** 14; **27** 116], field tests with it were carried out near Evesham in 1937–39. Those in 1937 were inconclusive owing to the lightness of the infestation. In 1938, a six-acre field of brussels sprouts set out on 14th June was available, but owing to drought the trial areas were not treated until 4th and 5th July, when about ¼ pint of a suspension of mercurous chloride (8 oz. in 60 gals. water) was applied once round the base of each plant. Counts in August showed that the percentages of severely infested plants in treated and untreated areas were 4·7 and 16·6, respectively, which is considered satisfactory in view of the adverse conditions. In 1939, the mercurous chloride was applied in the form of a 4 per cent. dust, in view of the results obtained by Wright [**27** 116]. Four acres of brussels sprouts set out on 15th May were available, and all but ¼ acre was treated on 18th May and again on 1st June. Counts in September showed that 75 per cent. of the untreated plants were badly infested, as compared with about 14 per cent. of the treated ones. In further tests, cauliflowers set out on 26th June were dusted 4 days later, only one application being made on account of wet weather and a heavy growth of weeds. The subsequent percentage infestation among the treated plants was under 3, while on untreated ones it was over 30. It is recommended that

cauliflowers should be dusted as soon as possible after transplanting, since plants set out in a private garden on 22nd May 1939 and not treated until the 27th May suffered severe infestation.

In view of a statement that a 1 per cent. solution of chloric acid is used against the eggs of *H. brassicae* in the Russian Union, tests were made in 1939 on cauliflowers by pouring about ¼ pint solution at that strength round the base of each plant soon after setting out. No protection against infestation was given.

BENNETT (S. H.). **Experiments on the Control of the Chafer Beetle *Phyllopertha horticola* L. in Grassland. Progress Report I.**—*Rep. agric. hort. Res. Sta. Bristol 1939* pp. 72–76, 3 refs. Bristol [1940].

Considerable damage is caused to old grassland in south-western England by the Rutelid, *Anomala* (*Phyllopertha*) *horticola*, L. [*cf. R.A.E.*, A **23** 631]; the infestation involves direct loss of hay or pasture herbage at the time of attack, and subsequent serious depreciation of the turf owing to the development of coarser kinds of grasses. Attacks have become more widespread during the last few years, and their control is becoming urgent. Grassland on light, well drained soils is most subject to injury, meadows left rough or not mown or grazed until late in the season being very susceptible. Infestation is often indicated by the presence of birds tearing up the grassland while hunting for the grubs, though this does not always occur, and the infested land becomes spongy as the grasses and other pasture plants lose their roots, while turf can easily be pulled up in September and large dead patches appear. In a serious attack the larvae may number 1½ millions per acre. The infestation sometimes occurs for only one or two years, but usually increases in severity over a period of years and extends to neighbouring grassland.

The adults emerge from their pupal cells in late May and early June and live for about a month, feeding on the leaves of deciduous trees, broad-leaved weeds and young bracken. They pair on sunny days, and fly mainly on warm evenings; dark wet days restrict movement. Oviposition begins 10–15 days after emergence, females burrowing into the soil and depositing their eggs 1–2 ins. below the surface. The larvae hatch in 15–20 days and feed on roots, descending to a depth of 7 or more inches as the soil temperature drops. Even the prolonged frost in January and February 1940, when the soil at a depth of 8 ins. was frozen for 28 days, failed to give a high kill of larvae in all soils. In April, the larvae move upwards and pupate in earthen cells 4–6 ins. below the surface of the soil, and the pupal stage lasts about a month.

The application of naphthalene [*cf. loc. cit.*] is the only measure that has so far given any control of the larvae, but the results have been inconsistent. In experiments with various insecticides in 1939, a piece of grassland on fairly light soil was divided up into plots of 6 sq. ft. enclosed in wooden-sided cages sunk into the soil to a depth of 14 ins., and 100 second-instar larvae were introduced into each at the end of August. Whizzed naphthalene (grade 16) broadcast at the rates of 2, 4 and 8 cwt. per acre and watered in with 4 pints water, gave 12, 45 and 60 per cent. mortality of the larvae, respectively. The other insecticides were emulsified with 20 per cent. sulphite lye [*cf.* **25** 710], and the diluted emulsions were applied at the rate of 4 pints per plot. An emulsion containing a solution of 1 lb. paradichlorobenzene and 4 lb. grade 16 naphthalene in 1 gal. kerosene and used at

a concentration equivalent to 4 cwt. naphthalene per acre gave 75 per cent. mortality. An emulsion of a saturated solution of grade 16 naphthalene in carbon bisulphide, applied at a concentration of 0·64 per cent. naphthalene, killed 80 per cent. of the larvae, while emulsions containing 0·48 and 1·28 per cent. orthodichlorobenzene killed 45 and 100 per cent., respectively, but the former concentration caused slight and the latter very severe damage to the grass. An emulsion containing 1·28 per cent. dodecyl thiocyanate (rhodanate) gave 50 per cent. mortality, while emulsions of 1 and 2 per cent. butyl carbitol thiocyanate (β-butoxy-β′-thiocyanodiethyl ether) gave 50 and 85 per cent., respectively, but caused severe damage to the grass. On the untreated plots the percentage larval mortality was 5. In field trials in two seasons, naphthalene was applied in autumn to pasture land at the rate of 2 cwt. per acre. The larvae were in the third instar and near the surface, but only 20 and 30 per cent., respectively, were killed. It is concluded that none of the insecticides tested is sufficiently toxic at economic or safe concentrations.

Walton (C. L.). **A Note on the Caddis-fly, *Limnophilus lunatus* Curtis, as a Pest of Cultivated Watercress.**—*Rep. agric. hort. Res. Sta. Bristol 1939* pp. 77–78. Bristol [1940].

Early in April 1939, considerable damage to cultivated watercress was reported from an extensive planting in Wiltshire and a series of small beds in north Somerset, and investigations revealed that in both cases the beds were swarming with larvae of a caddis fly later identified as *Limnophilus lunatus*, Curt. The damage consisted mainly in the destruction of the leaves for food and for the construction of the larval cases, and as the foliage diminished and the larvae grew in size, the stems also were attacked. There was also evidence of frost injury, which weakened the plants, while large numbers of water snails (*Limnaea*) were found among the roots. In some cases, the beds were so severely injured that extensive bare patches occurred, while in others detached stems drifted in masses, all swarming with larvae.

In Somerset, the snails were first destroyed with very dilute solutions of copper sulphate (which also killed many leeches and worms), and the Limnophilid larvae were then killed by means of derris, also used in great dilution (approximately 0·001 per cent. rotenone in the water). This treatment proved satisfactory, and later reports confirmed that the beds were clear of all pests. It is emphasised that both copper sulphate and derris are toxic to fish.

Large (E. C.). **The Advance of the Fungi.**—Demy 8vo, 488 pp., 6 pls., 58 figs., 26 pp. refs. London, Jonathan Cape, 1940. Price 18*s*.

The problems connected with insect and fungous pests of crops often show a marked similarity, and in many cases the same materials are employed in the control of each. This historical account of the development of knowledge relating to fungous pests and their control since the 18th century, when the practice of cultivating single crops on a large scale, which favours the incidence of pests, replaced the multiple cropping system, contains information of general interest to economic entomologists.

An account of the establishment of *Phylloxera* [*vitifoliae*, Fitch] in vineyards in France and the elucidation of its life-history forms the

basis of one chapter, and reference is made to locusts, *Leptinotarsa* (*Doryphora*) *decemlineata*, Say, pests of coffee in Ceylon, the association of woolly Aphids [*Eriosoma lanigerum*, Hsm.] with canker on apple trees, the development of summer and winter sprays and fumigation to control insect pests of orchards, and the transmission of fungous diseases by insects, and of fire-blight of pears by honey-bees. Other chapters deal with virus diseases and their transmission by Aphids and Jassids, the development of spraying and dusting materials and equipment and of legislative measures connected with them, the establishment of official bodies to deal with pest problems, and the work of the various experimental stations in the British Isles and the United States.

Fall Cultivation in Relation to Insect Control in Alberta.—1 p. multigraph. Ottawa, Public. Ext. Div. Dep. Agric., 1940.

In Alberta, grasshoppers and the wheat stem sawfly [*Cephus cinctus*, Nort.] can be successfully controlled by deep autumn ploughing of stubble lands ; the soil must be well turned with a mouldboard plough so that grasshopper eggs and stubble infested with larvae of *Cephus* are completely buried to a depth of 5–6 ins. of soil, leaving no opening through which the insects can emerge in the spring. If ploughing is impracticable, however, because of lack of moisture in autumn and the tendency of the ploughed lands to drift during the winter and early spring, shallow tillage, which leaves the stubble on the surface as a "trash cover," is advisable, the soil being cultivated to a depth of not more than 2 ins. The grasshopper eggs will thus be scattered on the surface of the soil and dry out. Though the effect of this method on the overwintering larvae of *Cephus* is variable, it may considerably reduce the potential infestation during the following season.

Dawsey (L. H.). **Factors influencing the Use of some common Insecticide-dispersing Agents.**—*Circ. U.S. Dep. Agric.* no. 568, 9 pp., 4 refs. Washington, D.C., 1940.

The following is largely the author's summary : Certain factors considered as affecting the efficiency of dispersing agents for insecticides, comprising dispersing efficiency, cost, versatility in dispersing different kinds of material and stability against water-hardness, heat, and bacteria, were investigated in the laboratory for 14 commonly used agents. Dispersing efficiency was gauged by the minimum quantity of the dispersing agent needed to produce a stable suspension or emulsion under a selected set of conditions. An agent was classified as stable if it was unaffected by heat, acids and bacteria, or if it was preservable by artificial means.

The dispersing agents were tested with refined petroleum oil, thiodiphenylamine (phenothiazine), menhaden fish oil and resin residue, all of which are commonly used in insecticides, and with melted paraffin wax to which benzene was added in the proportion of 3 : 2 by weight. Paraffin wax shows promise as a cheap protectant for organic insecticides that are subject to oxidation and photochemical decomposition when used out-of-doors ; the addition of benzene lowered its melting point from 52°C. to approximately 35°C.

The best all-round agent was gum arabic, because it possessed efficiency, low cost, resistance to decomposition, versatility, cleanliness, and ease in handling. In the unstable class, which was composed

largely of agents of animal origin, blood albumen, egg albumen, ammonium caseinate, glue, and whole-milk powder were generally more efficient than members of other groups. Their chief usefulness appeared to lie in the preparation of insecticidal sprays that are to be used within 24 hours after mixing. Only 4 of the agents were capable of dispersing all the materials. Of these, gum arabic was the best in the stable class for all the insecticides except menhaden fish oil, for which bentonite clay was the best, regardless of class. In the unstable class, blood albumen was best for refined petroleum oil; whole-milk powder for resin residue; ammonium caseinate for paraffin wax; and whole-wheat flour for thiodiphenylamine.

MACKIE (D. B.) & CARTER (W. B.). **The Fumigation of fresh Fruit with Methyl Bromide under industrial Conditions.**—*Bull. Dep. Agric. Calif.* **29** no. 2 pp. 78–86, 5 figs. Sacramento, Calif., 1940.

In view of the promising results given by the fumigation with methyl bromide of pears infested with newly hatched larvae of the second generation of the codling moth [*Cydia pomonella*, L.], which are difficult to detect at the time of picking [*cf. R.A.E.*, A **28** 63, 187], and the severity of this type of infestation in Bartlett pears harvested for shipment from California to eastern markets in 1939, their fumigation on a large scale was started in July, and the equivalent of 1,956 carloads was treated with methyl bromide at the rate of 2 lb. per 1,000 cu. ft. for 2 hours. Some of the fruit was treated in railway refrigerator cars or trucks, and some under gas-tight rubberised tarpaulins. The cost of fumigation and the saving afforded to growers are discussed. In addition, several thousand boxes of winter pears were fumigated by the same method against *Pseudococcus maritimus*, Ehrh., and all stages of the mealybug, including the eggs, were destroyed. During the summer, about 20 cars of mixed fruits, including pears, plums and peaches, were treated, and no reports of injury to the fruits were received. The concentration of the fumigant that was effective against *C. pomonella* destroyed the peach twig borer, *Anarsia lineatella*, Zell., in plums and peaches. About 5,000 boxes of apples were also successfully fumigated against *C. pomonella*. The apples were treated within a week after picking and suffered no injury, whereas in 1938 apples taken out of cold storage and fumigated with methyl bromide were severely damaged. Susceptibility to injury appears furthermore to vary with the variety.

The technique of the fumigation is discussed. The necessity for the operators to have gas masks and a halide leak detector to test cars under fumigation is emphasised. Fruit that has been precooled or under ice should not be treated, and the fumigation should be carried out only at temperatures of between 65 and 95°F. in the car. The rate of application of the methyl bromide should be not less than 4 or more than 5 lb. per car with an exposure of 2 hours, and the fumigant should be injected through a $\frac{1}{4}$ in. copper tube, which may be inserted through the door or into the bunker. All bunker drains should be plugged. A fan should be placed on top at each end of the load, unless a precooling fan is used, when one is sufficient. After fumigation, the gas should be dissipated either by blower or by airing the car for 30 minutes. Refrigerator trucks that are to be fumigated should be so loaded that a fan can be installed on the top of the load to prevent gas stratification. The fans should be started before the fumigant is

injected, and to prevent the liquid from being sprayed directly on to the fruit, the end of the tube should be inserted into a pail. Pears in boxes were successfully fumigated under tarpaulins. It is recommended that this type of fumigation should be carried out in the shade or at night on account of the heat generated under the tarpaulin by direct sunlight. The boxes should be arranged not more than six high in four square stacks separated by two alleys in which are placed fans pointing upwards at an angle of 45°. The edges of the tarpaulin should be covered with earth, etc.

Smith (R. H.). **History of the Nigra Scale in California.**—*Bull. Dep. Agric. Calif.* **29** no. 2 pp. 102–105, 6 refs. Sacramento, Calif., 1940.

Saissetia nigra, Nietn., which was recorded in California for the first time from a greenhouse in 1906, has during the last ten years become an important pest of many varieties of shrubs and trees in the open in the coastal region, and in southern districts is now the most common Lecaniine Coccid on ornamental woody plants. It has been recorded on over a hundred species of plants in California, and is widely established in ten counties. Its present widespread occurrence may have originated from a single foreign introduction, or it may have been repeatedly brought into the State on plants from abroad, as is indicated by its frequent interception in quarantine [*cf. R.A.E.*, A **20** 40]. Its increase has been particularly rapid in recent years; thus, in Los Angeles County it was collected by agricultural inspectors 130 times in 1938 as compared with only 15 times in 1933. Observations for several years are, however, required before its economic importance, biotic potential and environmental resistance can be determined. Early records of its occurrence in California are reviewed from the literature.

Landis (B. J.) & Howard (N. F.). *Paradexodes epilachnae*, **a Tachinid Parasite of the Mexican Bean Beetle.**—*Tech. Bull. U.S. Dep. Agric.* no. 721, 31 pp., 23 figs., 5 refs. Washington, D.C., 1940.

Epilachna varivestis, Muls. (*corrupta*, Muls.) has been present in the south-western United States for about 85 years, but no natural enemies capable of exerting control have appeared there. In 1922, the Tachinid, *Paradexodes epilachnae*, Aldr., was discovered parasitising the larvae in Mexico [*R.A.E.*, A **11** 344], but attempts to introduce it into the United States in 1923 were unsuccessful. A detailed study of it was therefore made in Mexico during 1929–30, and an account of this work and of further attempts to introduce it during 1930–35 is given in this paper. These attempts were unsuccessful, as though it usually became established in the season of release, it apparently failed to survive the winter.

Its hosts in Mexico include *E. varivestis*, *E. mexicana*, Guér., *E. defecta*, Muls., *E. obscurella*, Muls., and *E. virgata*, Muls.; in addition, it was successfully reared on *E. borealis*, F., in the laboratory in Ohio. Brief notes are given on the food-plants, bionomics and appearance of these Coccinellids, and all stages of *P. epilachnae*, the adult genitalia, the bionomics and the habits of the larvae are described. In Mexico, parasitised larvae of *Epilachna* were present in the field

from 7th June until 3rd December, but no resting stage long enough to carry the parasite through the winter occurred in the laboratory, and it is probable that in some regions of Mexico less affected by seasonal drought host larvae are present and sustain a small population of the parasite throughout the year. The maximum observed parasitism in larvae of *E. varivestis* was 81·4 per cent., in November 1929. Notes are given on a number of hyperparasites bred from puparia of *P. epilachnae*. The most abundant in Mexico was the Chalcid, *Brachymeria carinatifrons*, Gah. [**24** 299]. The Ichneumonid, *Phygadeuon subfuscus*, Cress., was obtained from puparia of *Paradexodes* sifted from soil in Ohio in March and September 1935, and adults of an undescribed species of *Myrmecopria* were also obtained from the September collection. The dates of emergence suggested that *Myrmecopria* was parasitic on *Phygadeuon* rather than on *Paradexodes*.

Tests established that the large predacious Coccinellids were not attacked by *P. epilachnae*, and shipments of parasite material yielding 60,000 puparia were received in Ohio from Mexico between 20th July 1929 and 12th October 1930. Attempts to store larvae, puparia and adults at various temperatures during the winter were unsuccessful, and the stock was maintained by continuous breeding, by a rearing technique that is described, for a period of over 5 years, during which approximately 60 generations were reared. During the 8 months of the year in which host larvae did not occur in the field, larvae of *E. varivestis* were also reared in the laboratory. The parasites were easy to rear ; females lived for as long as 74 days, and males for slightly less. The sexes were present in approximately equal numbers, and some females laid viable eggs almost daily for 39 or more consecutive days. Nearly 20 per cent. of the parasites died during the first 3 days of adult life, however, mortality being highest among females, and this, together with superparasitism, which was frequent both in the field and in the laboratory, accounted for a loss of 75 per cent. of the eggs under laboratory conditions. The total number of puparia produced by a single female averaged 42. The eggs, which are deposited on larvae of all instars and newly formed pupae, hatch immediately and the larva enters its host within 15–30 minutes. When fully fed (after 9·4–12·8 days during June–October 1932), the larva generally leaves its host and pupates in the soil, but sometimes, especially in *E. mexicana*, it pupates within the remains of the host.

During 1930–35, 145,500 adult parasites were bred, and 82,000 were liberated in 85 localities in 19 States. Each colony comprised 100–4,000 individuals ; in some districts more than one liberation was made in a season, and parasites were often released at the same point in several consecutive years. In general, a high degree of parasitism was obtained within a radius of several miles from a colony of 100–200 after 2 generations (60 days), and there was no appreciable parasitism at the point of liberation until after 30 days. Parasites were observed as far as 11 and 18 miles from the points of release in two States, and in a third, the percentage parasitism at a point 1 mile distant from that at which parasites had been liberated 50 days earlier reached 20·6. The tendency to spread probably depends on the environmental conditions at the point of release, since adults were most abundant on bean plants shaded by weeds or trees, and the degree of parasitism was highest in weedy or shaded fields. In Ohio, the rate of parasitism increased throughout the season, but the parasite was not recovered in the year following liberation in any locality in the United States.

HARRAR (J. G.) & MARTLAND (J. G.). **A fungous Parasite of the Pine Bark Beetle.**—*Phytopathology* **30** no. 1 p. 8. Lancaster, Pa., 1940.

During the spring of 1939, collections of bark of *Pinus echinata* from eastern Virginia were found to be infested with the larvae of *Dendroctonus frontalis*, Zimm., many of which were dead or dying. Examination showed that large numbers of the affected larvae were infested with a fungus, tentatively identified as *Beauveria* sp., and with Nematodes. Subsequent experiments showed that the fungus could live as a parasite of insects.

LEACH (J. G.). **Fungi associated with *Scolytus multistriatus* in Regions where *Ceratostomella ulmi* has not been found.**—*Phytopathology* **30** no. 1 p. 15. Lancaster, Pa., 1940.

The fungi that appeared to be consistently associated with *Scolytus multistriatus*, Marsh., in south-western West Virginia and fruited abundantly in its brood galleries in elm were *Graphium* sp., *Penicillium* sp., *Fusarium* sp., and one or more species of yeast. These fungi are believed to create a micro-environment favourable to the larvae. The Scolytid is multiplying rapidly in West Virginia in trees killed by phloem necrosis, and conditions exist that would favour the rapid spread of *Ophiostoma* (*Ceratostomella*) *ulmi*, the cause of Dutch elm disease, if this fungus were introduced.

MCDANIEL (E. I.). **Mid-Summer Sprays with Lead Arsenate to control the Hickory Bark Beetle.**—*Quart. Bull. Mich. agric. Exp. Sta.* **22** no. 4 pp. 243–245. East Lansing, Mich., 1940.

Periodic damage to hickory by *Scolytus quadrispinosus*, Say, is common in all parts of the United States east of the Mississippi River. Severe outbreaks are restricted to mature stands, in which the beetle population increases until all mature trees have been killed. Although the adults also feed on walnut and pecan, breeding is restricted to hickory, all varieties of which are attacked. The adults enter the bark under a bark flake or lenticel, and excavate vertical egg galleries, 1–3 ins. long, between the bark and the wood. The larval mines begin at right angles to the brood chamber, but gradually curve up or down, following the grain of the wood. In Michigan, this Scolytid has two generations a year. A period of adult emergence occurs about the third week in June, when the beetles feed for 3–5 days on the terminal growths or at the base of the leaves before they enter the bark. The feeding on the terminal growth is difficult to detect, but that at the leaf bases either kills the leaves or causes them to drop. The fallen leaves are indicative of the degree of infestation and the relative size of the outbreak.

Experiments on control by spraying were begun in Michigan in mid-summer 1937 in a natural grove of hickory over 75 years old that had been infested for 3–4 years. The spray was 4 lb. lead arsenate and a sticker (there being no difference in the efficiency of the two used) in 100 U.S. gals. water. The first application was made on 19th June, and was directed to the terminal growth and foliage and also upwards under the bark. The second was made on 11th August, and only the bark was sprayed, with the aim of penetrating any established

egg tunnels. When the trees were examined in September, the foliage appeared normal and no insects were found. The stand was examined again from time to time throughout the growing seasons of 1938 and 1939, and no injury by *S. quadrispinosus* was detected. It is concluded that one thorough application of lead arsenate, with a spreader, made while the beetles are feeding externally prior to entering the bark, is effective.

HUTSON (R.). **Spraying for Grapeberry Moth Control, 1939.**—*Quart. Bull. Mich. agric. Exp. Sta.* **22** no. 4 pp. 263–265. East Lansing, Mich., 1940.

During 1939, 8 spray programmes for controlling the grape-berry moth [*Polychrosis viteana*, Clem.] were tested in a moderately infested vineyard in Michigan. A description of the spray equipment is given, and the results are shown in a table. The materials used were lead arsenate, calcium arsenate, nicotine sulphate, fixed nicotine (Black Leaf 155 and Black Leaf 155 Concentrate) and cuprous cyanide (Kutane); adhesives (oil or calcium caseinate) were used with most sprays but not with cuprous cyanide. In all programmes, an arsenical was used in the first two, three or four sprays, and nicotine was the only insecticide in the fifth. With one exception, five sprays were given, the first when the shoots were 4–6 ins. long, the second and third immediately before and after flowering, and the fourth and fifth at intervals of a week.

All programmes gave over 95 per cent. uninfested grapes, and calcium arsenate proved quite as effective as lead arsenate, which suggests a possibility of reducing costs and eliminating lead residues. Fixed nicotine and cuprous cyanide were satisfactory, and further studies on them are to be made, particularly as the effectiveness of the fixed nicotine may render it possible to control both *P. viteana* and grape leafhoppers [*Erythroneura*] with this one material.

HILL (S. O.). **Pecan Foliage as Food for the Pecan Nut Casebearer *Acrobasis caryae* Grote.**—*Florida Ent.* **23** no. 2 pp. 27–29. Gainesville, Fla., 1940.

With a view to explaining the survival of the larvae of *Acrobasis caryae*, Grote, in seasons in which there are no nuts on the pecan trees, laboratory experiments were carried out in Florida in the summers of 1938 and 1939 to determine whether this Pyralid could complete a generation on pecan foliage alone [*cf. R.A.E.*, A **28** 572–573]. The technique used is described. In the first series of tests, larvae were successfully reared on pecan twigs or on pecan leaves; the percentages that reached the adult stage were small, but this was probably due to faulty technique. In 1939, when the technique was improved, 55 per cent. of the larvae reared on pecan leaves gave rise to adults. The larvae reared on leaves and twigs completed development within the same period as those reared on pecan nuts.

It was observed in the course of these investigations that the condition of the food is the predominant factor regulating the migration of the larvae to places of hibernation. Thus, when the food became dry and hard, the larvae migrated to the sides of the container and constructed hibernacula similar to those in which the winter is normally

passed. In August and September, when the leaves were not so succulent as earlier in the season, it was almost impossible to induce the larvae to feed. This condition also occurred in the field.

The Japanese Beetle taken in Florida.—*Florida Ent.* **23** no. 2 p. 30. Gainesville, Fla., 1940.

According to reports from the United States Bureau of Entomology and Plant Quarantine and the State Plant Board, five examples of the Japanese beetle [*Popillia japonica*, Newm.] have been taken in Florida, two each in Jacksonville and Miami and one in Tampa.

Hawley (I. M.) & Metzger (F. W.). **Feeding Habits of the Adult Japanese Beetle.**—*Circ. U.S. Dep. Agric.* no. 547, 30 pp., 11 figs., 11 refs. Washington, D.C., 1940.

The following is based on the authors' summary: By the end of 1938, *Popillia japonica*, Newm., had spread over an area of 15,100 square miles in six of the eastern United States and the adults had been observed to feed to varying extents on over 275 species of plants. In feeding, the beetles skeletonise the leaves, which turn brown and, in most cases, fall. They eat irregular portions from thin leaves with fine venation and from flower petals, and small portions from the upper surface of thick leaves. They often collect in large masses called " balls " and feed extensively on such preferred fruits as apples and peaches until only the core or stone remains; balling sometimes occurs also on the foliage and flowers of food-plants. Feeding is heaviest on the foliage of upper and outer branches between 9 a.m. and 3 p.m. on bright sunny days, at temperatures between 85 and 95°F.; it is light at temperatures below 70 and above 95°F. When the relative humidity is below 50–60 per cent., the adults fly actively and feed very little, but when it exceeds 60 per cent. activity is reduced and feeding increased. In general, the degree of feeding on any plant species depends on its attractiveness and the abundance of beetles in the vicinity. The succulency of the foliage of a plant and the odours given off by the fruit and leaves may explain to some extent the preference shown for certain plants, but the only known factor that renders many plants attractive is a high content of reducing sugar in the part most usually attacked [*cf. R.A.E.*, A **23** 342]. Certain plants, such as geranium, castor (*Ricinus communis*) and bottlebrush buckeye (*Aesculus parviflora*), are reported to be toxic to beetles feeding on them [*cf.* **21** 253].

The scientific and popular names of 277 plants are classified in four tables according to whether the injury resulting from feeding is severe, moderate, or generally or occasionally light, and a list of 89 common plants on which feeding has never been observed is also included.

Felt (E. P.) & Bromley (S. W.). **New Insecticides and Spreaders on Shade Trees.**—*J. econ. Ent.* **33** no. 2 pp. 247–249. Menasha, Wis., 1940.

This paper includes a series of notes on the results of tests of a number of proprietary insecticides and spreaders in sprays against pests of shade trees in the north-eastern United States. Small-scale experiments in south-western Connecticut in the spring of 1939 indicated that dusting with cubé or very fine sulphur controlled very young

larvae of *Malacosoma americana*, F. Tests with colloidal and ordinary lead arsenates, made in 1936–38, showed that, at the rate of 1 lb. per 300 U.S. gals. water, both gave fair control of young larvae of *M. americana* and of larvae of *Nymphalis antiopa*, L. (spiny elm caterpillar) and a sawfly on oak, while both were completely ineffective against *Popillia japonica*, Newm., and *Alsophila pometaria*, Harr., and it is concluded that particle size has little effect on the toxicity of lead arsenate.

A series of laboratory tests in 1939 showed that basic copper arsenate, applied before the larvae began feeding, protected foliage of black walnut [*Juglans nigra*] from attack by *Datana integerrima*, G. & R., *Halisodota caryae*, Harr., and *Hyphantria cunea*, Dru., but was less effective against other pests. It caused typical copper injury to the fruit and foliage of apple, and though the sprayed shade trees were uninjured, filbert [*Corylus*], *Forsythia* and lilac growing underneath developed characteristic arsenical injury. In cage tests on *P. japonica*, basic copper arsenate was less repellent than lead arsenate and killed the beetles more slowly. Its action against larvae of a Lymantriid, probably *Dasychira* (*Olene*) *achatina*, S. & A., was also very slow compared with that of lead arsenate, which, however, gave only fair control at ordinary strengths.

BUCHANAN (W. D.). *Scolytus sulcatus* **Lec. transmits Dutch Elm Disease Fungus under controlled Conditions.**—*J. econ. Ent.* **33** no. 2 pp. 250–251, 1 ref. Menasha, Wis., 1940.

A few instances, observed in recent years in New Jersey and New York, are given of infestation by *Scotylus sulcatus*, Lec., of elm trees attacked by Dutch elm disease, and the isolation of the fungus, *Ophiostoma* (*Ceratostomella*) *ulmi*, from adults of this Scolytid in 1938 is recorded [*cf. R.A.E.*, A **27** 77]. In nature, however, it is more abundant on apple than on elm, and when it breeds in the latter, it has probably migrated from neighbouring apple trees.

In preliminary experiments in 1938, adults of *S. sulcatus* bred from apple were artificially contaminated with *O. ulmi* in May and June and about 33 were caged on each of six young elm trees. Three of these trees developed typical symptoms of Dutch elm disease; and the fungus was isolated from these. The experiment was repeated with similar results in 1939, and in a second experiment artificially contaminated beetles were introduced into a cage containing ten elm and two apple trees and elm and apple logs. They oviposited in both elm and apple logs and penetrated the bark to the sapwood an average of 96 times per tree in the elms and 4 times per tree in the much smaller apples, 95 and 88 per cent., respectively, of the injuries being in the twig crotches. *O. ulmi* was isolated from two elms that had developed typical symptoms and from one of the apple trees, which, however, showed no external symptoms of the disease. It has been shown that *O. ulmi* will spread to the crown of an apple tree when inoculations are made in the base, and that the fungus is viable for almost a year in sections of inoculated apple trees stored in deep shade.

In June 1938, adults of *S. sulcatus* were caged with logs from a diseased elm tree and oviposition was obtained. In May 1939, each log was placed with a healthy nursery elm tree, and adults emerged in June and fed at will on the trees. Typical symptoms developed in three of the four trees, and *O. ulmi* was isolated from them.

The author points out, however, that though the experiments show that *S. sulcatus* is able to transmit *O. ulmi* under controlled conditions, there is no proof that it does so in nature.

GAMBRELL (F. L.). **Rotenone-bearing Insecticides for the Control of the Elm Leaf Beetle,** *Galerucella xanthomelaena* **Schrank.**—*J. econ. Ent.* **33** no. 2 pp. 264–269, 3 refs. Menasha, Wis., 1940.

The following is largely based on the author's summary of tests carried out in 1938 and 1939 on the comparative value of rotenone-bearing insecticides and lead arsenate for the control of *Galerucella luteola*, Müll. (*xanthomelaena*, Schr.), which has caused serious damage to elm trees in many areas of western New York for several years. The close correlation between plant growth and the activity and development of the beetle, particularly the emergence of adults from hibernation, feeding, egg laying and hatching, in different years is shown.

Experiments in 1938 indicated that sprays containing either 4 lb. cubé powder (4 per cent. rotenone) or 6 lb. lead arsenate per 100 U.S. gals. water were quite effective when applied after more than half of the eggs had hatched. In 1939, spray mixtures containing either 2–4 lb. derris (about 5 per cent. rotenone) or 4–6 lb. lead arsenate per 100 U.S. gals. water gave satisfactory control if applied during or after the second week in June. In limited tests, a 2·5 per cent. rotenone extract, diluted to 1 : 400, effected a high degree of control of both larvae and adults. In field tests there was no appreciable difference between the effectiveness of ordinary derris and stabilised derris (containing an anti-oxidant), with the possible exception of the influence on eggs. In two localities, the proportion of eggs failing to hatch was much greater after the use of stabilised derris than after ordinary derris applied on 6th and 9th June, respectively.

Though rotenone may not entirely replace lead arsenate in sprays against *G. luteola*, it seems probable that it will be preferable under certain conditions. Its advantages include lack of objectionable residue, relative safety to man and animals and rapidity of kill, and its disadvantages are the danger of poisoning fish, the cost of the material and possibly lack of adhesion on foliage during wet weather. The rapid kill is particularly important when sprays are applied rather late in the season and immediate relief from foliage injury is desired. The lack of adhesion may not prove to be serious, as the material should be applied to the under surface of the leaf, and much of its effectiveness apparently results from the contact action of the spray within a short time of its application.

BEARD (R. L.). **Parasitic Castration of** *Anasa tristis* **DeG. by** *Trichopoda pennipes* **Fab., and its Effect on Reproduction.**—*J. econ. Ent.* **33** no. 2 pp. 269–272, 2 figs., 3 refs. Menasha, Wis., 1940.

The results of investigations on the effect on reproduction in *Anasa tristis*, DeG., of parasitism by *Trichopoda pennipes*, F. [*cf. R.A.E.*, A **12** 213], which is common throughout the north-east of the United States, are summarised by the author as follows: Parasitic castration of the squash bug by the larva of the Tachinid is manifested by a progressive atrophy of the reproductive organs. This is due neither to a systemic effect nor to a strictly mechanical injury. The degeneration of the testes in the male bug causes no reduction in

reproductive activity. In the female, the loss of functional ovaries is reflected in a limited suppression of oviposition, the extent of which has been estimated for a natural population during the past three years.

MUNDINGER (F. G.). **Pentatomids attacking Tomatoes and Experiments on their Control.**—*J. econ. Ent.* **33** no. 2 pp. 275–278, 1 fig. Menasha, Wis., 1940.

Field and laboratory observations showed that a yellowish discoloration that appeared on the fruit of tomato at ripening time in western New York during the late summer of 1939 was caused by the feeding of Pentatomids, of which three species, *Euschistus variolarius*, P. de B., *E. tristigmus*, Say, and *Podisus maculiventris*, Say, were found on tomato plants and fruit. *P. maculiventris* is predacious and so probably does not injure the fruit [*cf. R.A.E.*, A **26** 596]. *E. variolarius*, all stages of which are briefly described, was the most prevalent species, and nymphs of all instars as well as adults fed on the tomatos ; ripe fruit seemed to be preferred, but some individuals were observed to feed on half ripe fruit and a few on green tomatos.

E. variolarius occurs on a variety of plants, including trees, shrubs, bush fruits and vegetables, and hibernates in the adult stage. The overwintering adults leave their shelter in the first warm days of spring ; they have been taken in the field as early as 24th April and some lived until the end of August. In 1933 and 1934, the oviposition period extended from about 24th May to 20th August. The eggs were occasionally laid singly, but usually in masses of 5–28, and hatched in 4–8 days. A captive female laid 122 eggs in 6 batches between 31st July and 15th August 1934. The five nymphal instars lasted 4–7, 6–18, 7–14, 7–16 and 12–27 days, respectively.

In cage tests with dusts carried out towards the end of August against batches of bugs in all stages of development, the majority being fourth-instar nymphs, Dry Pyrocide (0·3 per cent. pyrethrins) caused 87 per cent. mortality after 72 hours and 93 per cent. after 120 hours, whereas derris (1 per cent. rotenone) killed 39 per cent. and a dust of lime containing 4 per cent. nicotine only 4 per cent. in 120 hours. In a second series of tests, Dry Pyrocide was compared with two proprietary sprays and one containing nicotine sulphate (1 : 400) and soap. The sprays gave little control, but the results with the pyrethrum dust were similar to those in the first experiment. It was equally toxic to nymphs and adults.

ANDERSON (L. D.) & WALKER (H. G.). **Notes on the Control of Onion Thrips.**—*J. econ. Ent.* **33** no. 2 pp. 278–280, 1 fig., 1 ref. Menasha, Wis., 1940.

As spraying or dusting with nicotine, pyrethrum or rotenone or fumigation with hydrocyanic acid gas at permissible concentrations failed to give satisfactory control of *Thrips tabaci*, Lind., in greenhouses at Norfolk, Virginia, where it is frequently a serious pest on many vegetable crops, a solution of 2 lb. tartar emetic and 8 lb. brown sugar in 50 U.S. gals. water, applied as a fine mist at a pressure of 15 lb. per sq. inch, was tested. It was sometimes used with the addition of a burnt onion sauce or pure onion juice, but was equally effective without it. When applied in the greenhouse on 12th and 26th January, it kept onion plants free from thrips, whereas plants treated with an oil

emulsion containing rotenone were heavily infested and untreated plants were very severely injured by the end of January. Neither of the sprays injured the foliage. The tartar-emetic spray was applied on 1st, 20th and 27th March and on 6th April to the plants previously left untreated, and they had made a remarkable recovery from thrips injury by the middle of April; by this time those previously given this treatment but subsequently left unsprayed had been seriously injured. In another test, alternate rows of onion plants were treated with the tartar-emetic spray on 20th and 27th March and 6th and 14th April, while the others were left untreated. Within a week of the first application a difference in the amount of thrips injury could be detected readily, by 10th April the treated plants were more than twice the size of the untreated ones and when they were harvested on 2nd May the average weight of onions from treated and untreated plants was 22·4 and 6·3 gm. per plant, respectively. In a preliminary test the spray did not give such a good control of thrips on onions in the field.

One application of the spray to beans heavily infested with *T. tabaci* in the greenhouse reduced the number of nymphs by more than 97 per cent. and prevented reinfestation for at least 7 days, in addition to killing many undetermined species of flies. A list of other greenhouse vegetables on which the spray of tartar emetic and brown sugar gave good control of thrips without injury to foliage is appended.

PEPPER (B. B.). **Dichloroethyl Ether for Wireworm Control.**—*J. econ. Ent.* **33** no. 2 pp. 280–282, 3 refs. Menasha, Wis., 1940.

The results are given of tests carried out under field conditions in New Jersey in 1936–39 of dichloroethyl ether (emulsified with water to obtain thorough distribution) for the control of wireworms [Elaterids] attacking vegetable crops. Since wireworm infestations appear in localised areas in a field, treatments were made after the insects began to feed on the roots of the growing crops; before treatment the soil was hoed or ploughed round the plants to prevent excessive run-off of the liquid.

A dosage of 5 cc. dichloroethyl ether per plant showed signs of stunting the growth of cabbage, cauliflower, kale and broccoli, but 10 cc. per plant did not completely kill them; dosages of 1 and 2 cc. per plant appeared to stimulate the growth of cabbage, cauliflower and some other plants. The insecticide was applied in ½ U.S. pint water per plant. Tomato and cucumber appeared to be susceptible to injury from a dose of 2 cc. per plant or hill, but beets, swiss chard and horse-radish showed no injury from dosages of 5 cc. per U.S. pint water per linear foot of row space. A dosage of 0·5 cc. dichloroethyl ether per plant did not give adequate control of wireworms, but 1 cc. or more gave almost complete control on cabbage and related plants. The amount of water used apparently had little effect on the mortality of the insects, though this was only 40 per cent. when no water was used, and there was poor wetting of the soil immediately round the roots of the plants and consequently a low kill of wireworms when only 1 U.S. pint water per linear foot of row was used. No living larvae were found less than 5 ins. laterally from the base of the plants after treatment with 1 cc. or more; living larvae were sometimes found at depths of 6 or more inches, particularly under very dry conditions, but usually good vertical penetration of the chemical was obtained.

It appeared that for effective control dichloroethyl ether must be in solution or emulsion ; it is a poor fumigant but an extremely toxic contact insecticide. Larvae and puparia of the cabbage maggot [*Hylemyia brassicae*, Bch.], larvae of the Japanese beetle [*Popillia japonica*, Newm.], earthworms and garden centipedes [*Scutigerella immaculata*, Newp.] were destroyed by dosages that were toxic to wireworms.

Commercial treatment in 1939 of large plots of cabbage and cauliflower with ⅓ U.S. pint per plant of an emulsion of 1 fl. oz. dichloroethyl ether per U.S. gal. water killed the wireworms in the plots and resulted in a normal crop, whereas about half the plants in the untreated sections of the field were destroyed by wireworms.

DITMAN (L. P.), WEILAND (G. S.) & GUILL jr. (J. H.). **The Metabolism in the Corn Earworm. III. Weight, Water, and Diapause.** —*J. econ. Ent.* **33** no. 2 pp. 282–295, 7 figs., 9 refs. Menasha, Wis., 1940.

An account is given of studies on larvae and pupae of *Heliothis armigera*, Hb., from which the authors draw the following conclusions : Larvae attain greater size when reared at 24·4°C. [76°F.] than when reared at 30°C. [86°F.]. Pupae are larger when the prepupal period is spent in relatively wet soil than when it is spent in dry soil. Death of prepupae results from dehydration in dry soil (1–2 per cent. moisture) at 18·9°C. [66°F.] or below ; mortality is high among prepupae in wet soil (18–25 per cent. moisture) at 13·3°C. [56°F.]. Loss of weight during the pupal period varies inversely as the humidities at which the pupae have been stored ; soil moisture has a similar effect. At constant low humidity there is a greater weight loss during the entire pupal stage at cool incubator temperatures than at warm, a result of longer exposure. Pupae in diapause lose weight less rapidly at low humidity than pupae not in diapause. Differences in loss of weight at various humidities appear to be due entirely to variations in loss of water.

Diapause during the pupal period is caused by low temperatures during the larval period. Larvae reared at 18·9°C. produce pupae of which some groups diapause to the extent of 50 per cent. This explains the occasional occurrence of pupae undergoing diapause during the summer after cool weather, and the preponderance of pupae with a tendency to enter diapause always to be found in early autumn. Undercooling and freezing points and bound-water determinations indicate that even pupae not in diapause can survive temperatures below 0°C. [32°F.] for at least short periods. Preliminary attempts to cold-harden pupae indicate that alternating low and high temperatures are necessary, and that only individuals in diapause harden. Pupae not undergoing diapause resume their normal development during periods of warmth.

DONOHOE (H. C.), JOHNSON (A. C.) & BULGER (J. W.). **Methyl Bromide Fumigation for Japanese Beetle Control.**—*J. econ. Ent.* **33** no. 2 pp. 296–302, 2 refs. Menasha, Wis., 1940.

The following is substantially the authors' summary : Methyl bromide fumigation of fresh fruits and vegetables has been investigated, and commercial bases for application in the United States have been dev loped for use both in fumigation vaults and in loaded

refrigerator cars on railways. In specially constructed fumigation vaults, it has been shown that complete mortality of adults of *Popillia japonica*, Newm., can be obtained in both vault space and load in fumigations with a 2-hour exposure period, and that dosage is dependent on temperature. Complete mortality was obtained with dosages of 2 lb. methyl bromide per 1,000 cu. ft. at 65–90°F., of 1 lb. at 76–89°F., and of 0·75 lb. at 77–86°F. These are the results obtained in experimental fumigations involving 108,000 beetles.

A successful method for fumigating loaded refrigerator cars was developed in 1938 and put into immediate commercial use. It requires the use of a multivane blower with an air blast rating of 700 cu. ft. per minute free air, the introduction of a part of the dosage into each bunker of the car and the release of the methyl bromide through a disk-type spray nozzle. In 1938 the nozzle was directed downward, and though complete mortality was obtained, it was sometimes much delayed; in 1939 the nozzle was directed upwards to discharge towards the ceiling, and in all the experimental fumigations complete mortality was obtained within 24 hours. Work in 1939 indicated that a dosage of 3·5–4 lb. per car at temperatures of 80°F., or above, results in complete mortality. In the experimental car fumigations, over 5,000 larvae and about 110,000 adults of *P. japonica* were used. The treatment was commercially applied to almost 4,000 cars of produce during the 1938 and 1939 seasons of beetle activity.

White (R. T.). **Survival of Type A Milky Disease of Japanese Beetle Larvae under adverse Field Conditions.**—*J. econ. Ent.* **33** no. 2 pp. 303–306, 1 ref. Menasha, Wis., 1940.

The following is based on the author's summary of experiments carried out on a golf course in Pennsylvania in which larvae of *Popillia japonica*, Newm., were numerous and the turf was severely injured by them in 1935: The introduction of larvae infected with the type A milky disease organism into field plots in the autumn of 1935, when the soil temperature at the 3-inch level was below 60°F., the minimum for development of the causal agent [*cf. R.A.E.*, A **24** 292; **26** 324], resulted in the establishment of the organism, in spite of subsequent extremely abnormal climatic conditions that reduced the larval population to a minimum during the winter months. Likewise, neither the excessively wet condition of the soil nor the extreme dryness prevailing later, at certain times, lessened its effectiveness. By 1938, conditions permitted a great increase in the abundance of the insect in the general vicinity, but in the disease plots the numbers of larvae fell off to a marked extent, and the population in these plots continued at a low level through 1939. In 1938 the disease was found as far as 200 ft. from the plots, and in 1939 it was found in control areas as much as 500 yards away [*cf.* **27** 377]. No infected larvae were recovered nor was evidence of the presence of the causal agent found beyond a radius of 200 ft. from either plot until June 1939, further strengthening the original assumption that the causal organism did not exist in this locality prior to its introduction into the plots on 30th October 1935.

Data indicate that when once the soil becomes highly infectious with the causal agent, no substantial population of larvae of *Popillia* can exist. Serious turf injury can thus be reduced, if not entirely prevented, by the introduction of this disease. A rapid increase and

spread of the organism may be expected when a reasonably heavy larval population occurs. The ability of this agent to withstand adverse conditions and its permanence when once established emphasise its value as a factor in the economic control of *P. japonica*.

White (R. T.) & Dutky (S. R.). **Effect of the Introduction of Milky Diseases on Populations of Japanese Beetle Larvae.**—*J. econ. Ent.* **33** no. 2 pp. 306–309, 2 refs. Menasha, Wis., 1940.

In studies of numerous diseases affecting larvae of *Popillia japonica*, Newm., carried out at the Moorestown laboratory, New Jersey, during 1935–39, two diseases of the white group [*cf. R.A.E.*, A **24** 142], known as types A and B milky disease and produced by two closely related undescribed bacteria that grow and sporulate in the blood of the living larvae, showed the greatest promise for utilisation in control, owing to the extreme hardiness of the causal organisms [*cf.* preceding abstract] and the ease with which healthy larvae could be infected. Diseases of the white group were the most prevalent, affecting over 90 per cent. of all diseased larvae examined in field studies during 1935–36. Surveys and examinations of soil samples from areas in which the larvae had not yet become abundant failed to show the presence of the agents causing these diseases, but they have been established since 1935 in almost all the counties in New Jersey.

Various methods were employed for introducing the bacteria, including the planting of living inoculated larvae in the plot areas and the application of spore suspensions, spore-talc dusts and infectious soil ; and preliminary studies made in 1935–37 showed that successful establishment of either type of milky disease could easily be obtained by any of these methods. Living larvae were used as a culture medium, since no artificial medium has been found that permits the organisms to develop to the spore stage. Such larvae, inoculated and kept for 10–12 days in soil at 86°F., contained approximately 1,000–3,000 million spores. They were then ground and made into a suspension with water for immediate application or incorporated with powdered talc for storage. Relatively heavy dosages of infectious material were used in the work in New Jersey in 1935–37, but various dosages and intervals of application were used in field studies in several States in 1938 and 1939 to determine the minimum amount of material necessary. Approximate dosages of from 25 to 1,500 millions of spores per sq. ft., applied continuously or in patches, resulted in successful establishment and subsequent increase of the disease ; and it appeared probable that reduction of the larval population to a point at which no injury to turf occurs can be obtained with any of these dosages, the time required for this varying from one larval feeding season (spring or autumn) to several, according to the distance between points of application. Field and laboratory observations showed that birds and insects are important natural agents of dispersion [**27** 377].

Langford (G. S.), Cory (E. N.) & Whittington (F. B.). **Inexpensive Japanese Beetle Traps.**—*J. econ. Ent.* **33** no. 2 pp. 309–316, 10 figs. Menasha, Wis., 1940.

Langford (G. S.), Crosthwait (S. L.) & Whittington (F. B.). **The Value of Traps in Japanese Beetle Control.**—*T.c.* pp. 317–320.

These papers deal with the construction and co-operative use in Maryland in 1939 of traps for the control of *Popillia japonica*, Newm.

Details are given in the first paper of the development of a cheap trap that resulted in a saving of $30,000 in the State in 1939 [*cf. R.A.E.*, A **28** 521]. In the second paper it is shown that 5,338 traps on 6,749 acres of land caught approximately 30 per cent. of the estimated number of beetles produced in the area, though results obtained on individual farms indicated that a much higher efficiency was possible if one trap per acre was operated efficiently [*loc. cit.*]. Many individual farmers caught from 40 to over 100 per cent. of the estimated numbers of beetles produced on their properties. Though it was impossible to check accurately the value of traps in protecting crops, the results obtained showed that they did not give full protection against *P. japonica*, but could profitably be used to reduce crop losses.

Fleming (W. E.), Burgess (E. D.) & Maines (W. W.). **Relation of Color to the Effectiveness of Japanese Beetle Traps.**—*J. econ. Ent.* **33** no. 2 pp. 320–327, 4 refs. Menasha, Wis., 1940.

The following is based on the authors' summary of an investigation during the summer of 1939 to establish the most effective colour for traps for *Popillia japonica*, Newm., using a bait of 10 parts geraniol and 1 part eugenol by volume dispensed by means of a bottle and wick : Traps painted entirely yellow were definitely more effective than those painted aluminium, white, light yellow, light blue, dark blue, pink, red, orange, reddish orange and green varying in shade from light to dark and from yellowish to bluish. The evidence this season showed that a scouting trap painted with a yellow to which no other pigment was added caught 50·8 per cent. more beetles than the green and white standard trap that has been used extensively in recent years. The addition of yellow to other pigments always enhanced their effectiveness. It follows that to secure the greatest capture of the beetles attracted, the trap should be painted with a primary yellow.

It was demonstrated conclusively that a trap painted green and white is more effective than a green trap in capturing the Japanese beetles attracted to it. It was found, however, that when the baffle and the inside of the funnel of a green trap were painted white, the trap functioned as a white trap ; when these parts of a white trap were painted green, it performed as a green trap. The shade of green on the outside of the funnel and on the beetle receptacle was a minor factor. As the colour of the baffle and the inside of the funnel govern the effectiveness of the trap, there seems to be no necessity for using a dual colour scheme on the trap.

Jones (H. A.) & Haller (H. L.). **Properties of two Samples of commercial Geraniol used in Japanese Beetle Baits.**—*J. econ. Ent.* **33** no. 2 pp. 327–329, 1 ref. Menasha, Wis., 1940.

The physical and chemical properties of two samples of commercial geraniol, both of which meet the specified requirements for use in traps for *Popillia japonica*, Newm. [*R.A.E.*, A **24** 303–304] and a sample of pure geraniol are shown in a table. Fractional distillation of the commercial geraniols under greatly diminished pressure showed that one probably consisted of relatively few components, whereas the other appeared to consist of a number of components with widely different physical properties. The preliminary results of entomological tests on these two materials indicated wide enough differences among

commercial geraniols to warrant a more detailed investigation of the subject, leading to the development of further specifications, including possibly viscosity, optical rotation and chemical determinations sufficient to fix the composition of the material, that will give a product of still greater attractiveness to the beetles.

GOODHUE (L. D.) & SULLIVAN (W. N.). **Toxicities to the Housefly of Smoke from Derris and Pyrethrum.**—*J. econ. Ent.* **33** no. 2 pp. 329–332, 1 fig., 2 refs. Menasha, Wis., 1940.

In a test supplementary to the main one reported in this paper on the toxicity to *Musca domestica*, L., of smoke produced by burning mixtures of derris or pyrethrum with maize stalks and sodium nitrate [*R.A.E.*, B **29** 44], derris burnt at the rate of 4 oz. per 1,000 cu. ft. gave a very high kill of the bean aphis (*Aphis rumicis*, L.).

GINSBURG (J. M.). **Certain semi-refined Oils for Summer Spraying on Apple Trees.**—*J. econ. Ent.* **33** no. 2 pp. 332–336, 11 refs. Menasha, Wis., 1940.

The following is substantially the author's summary: Experiments were conducted over a period of several years in New Jersey with petroleum distillates of varying degrees of refinement for the purpose of selecting a cheap oil that could be safely sprayed on apple foliage as a substitute for the highly refined oil previously used. Blocks of apple trees as well as entire apple orchards containing different varieties were sprayed 5–6 times during one season with about 0·7 per cent. oil, mixed with either lead arsenate or nicotine, to control the first and second broods of the codling moth [*Cydia pomonella*, L.]. From the results obtained, it appears that a semi-refined paraffin distillate of about 70 viscosity and about 83 per cent. sulphonation, possessing a viscosity index of 90–100, is as safe for summer spraying on apple trees as is the highly refined oil. The cost of the semi-refined distillates is less than half that of the highly refined oil.

HARTZELL (F. Z.) & CHAPMAN (P. J.). **Field Tests for Rosy Aphid and Budmoth Control.**—*J. econ. Ent.* **33** no. 2 pp. 336–339, 3 refs. Menasha, Wis., 1940.

The results are given of tests with some of the newer dormant sprays against *Anuraphis roseus*, Baker, and *Spilonota ocellana*, Schiff., on apple in western New York in 1939, and of applications at the breaking-bud stage, defined as the period beginning when green tissue can be seen in 10 per cent. of the apple fruit buds and ending when green tips protrude from about 50 per cent. of the buds. Infestation by the Aphid was severe.

Dormant applications of lubricating oil (viscosity 100–108 secs. Saybolt at 100°F.) at concentrations of 4, 5 or 6 per cent. did not control *A. roseus* either alone or with nicotine sulphate (1 : 800), whereas alone at 5 or 6 per cent. or at 4 per cent. with nicotine sulphate it gave moderate control (80–89 per cent.) of *S. ocellana*. It is recommended that if 5 or 6 per cent. oil sprays must be used to control *Tortrix* (*Cacoecia*) *argyrospila*, Wlk., nicotine should be omitted from the dormant application and used in the delayed-dormant treatment with Bordeaux mixture or lime-sulphur; such a schedule would be effective against *A. roseus* and improve the control of *S. ocellana*.

High and low temperature tar oils [*cf. R.A.E.*, A **27** 535] at a concentration of 3 per cent. gave 59 and 65 per cent. reduction in infestation by *S. ocellana*, respectively; *A. roseus* was scarce in the orchard in which they were applied. Dinitro-o-cyclohexylphenol was used in two types of mixtures; in one a solution of 4 per cent. in 96 per cent. oil by weight was emulsified in the spray tank, and in the other the chemical, with varying amounts of other materials, was added to the oil after it had been emulsified in the spray tank. There appeared to be little difference in effectiveness between the two types against either insect; mixtures containing 2½–3 U.S. gals. oil and 12–14 oz. toxicant in 100 U.S. gals. spray gave good control (about 90 per cent.) of both. Elgetol, a preparation containing a sodium salt of dinitro-cresol, was highly effective (97–98 per cent. control) against *A. roseus* at concentrations of ½ per cent. or more and against *S. ocellana* at 1 per cent. or more. The ½ per cent. concentration was not tested against *S. ocellana*. Control of these insects was not improved by the addition of 3 per cent. lubricating oil, but that of *T. argyrospila* was decidedly better when oil was added to Elgetol than when Elgetol, even at higher concentrations, was used alone.

At the breaking-bud stage, a spray of 4 oz. dinitro-o-cyclohexylphenol and 2 U.S. gals. oil per 100 U.S. gals. spray caused no bud injury, but gave only slight control of *A. roseus* and *S. ocellana*. Elgetol gave excellent control of the Aphid and good control of *S. ocellana* at a concentration of ½ per cent., and excellent control of both insects with no bud injury at the rate of 1 per cent. Mixtures of 3 gals. lubricating oil with either 1 pint nicotine sulphate, ½ gal. cresylic acid or ½ gal. low temperature tar oil in 100 gals. spray gave moderate control of *S. ocellana* but were ineffective against *A. roseus*. The influence of wind and rain on control by the use of dormant and breaking-bud sprays is discussed.

HARMAN (S. W.). **Experiences in New York with Non-residue Sprays for the Codling Moth.**—*J. econ. Ent.* **33** no. 2 pp. 340–342. Menasha, Wis., 1940.

In view of the damage frequently caused to apples during the washing process in western New York, spray schedules that avoid the residue problem, including lead arsenate in the calyx and first summer applications, followed by nicotine sprays for the rest of the season, have been developed for the control of *Cydia* (*Carpocapsa*) *pomonella*, L., during the last few years. The effect of applying cover sprays containing no arsenical against the first brood and no sprays against the second was tested in 1939, when conditions were very favourable for the moth and particularly for a large and destructive second generation. The sprayed orchard had been heavily infested in the preceding year and the moths were numerous in it in late May. Applications of sprays containing a fixed nicotine (4 lb. Black Leaf 155), 3 U.S. quarts summer oil emulsion (83 per cent. oil) and either ½ or 1 U.S. pint nicotine sulphate per 100 U.S. gals. were made on 10th, 20th and 27th June and 5th and 17th July. By the middle of July it was difficult to find any sign of injury due to larvae of *Cydia*, though damage was common in neighbouring orchards. At harvest (18th September), the fruit was free from visible residue, and less than 1 per cent. had been injured superficially and less than 2 per cent. infested, probably by the second generation, even on trees that had received

the weaker spray. These results show that, in isolated orchards in the north-east of the United States, it is possible to control *C. pomonella* by sprays against the first generation only, even during a season favourable for injury by the second generation.

SIEGLER (E. H.). **Laboratory Studies of Codling Moth Larval Attractants.**—*J. econ. Ent.* **33** no. 2 pp. 342–345. Menasha, Wis., 1940.

The following is based almost entirely on the author's summary: Laboratory studies were made by the apple plug method [*cf. R.A.E.*, A **21** 338] of possible larval attractants for use in increasing the effectiveness of stomach poisons in the control of *Cydia* (*Carpocapsa*) *pomonella*, L. An attractant is particularly needed for more effective control of the larvae because of their habit of avoiding insecticidal deposits on the skin of the fruit.

All the attractants were used at the rate of 16 lb. per 100 U.S. gals. spray, and brown sugar was also used at lower rates in some tests with lead arsenate. Brown sugar, because of its availability and low cost, appears most promising. Its addition considerably increased the toxicity of lead arsenate, calcium arsenate, nicotine bentonite and phenothiazine [thiodiphenylamine]. In combination with Paris green, it decreased the number of plugs superficially injured, but had little effect on the proportion entered by the larvae. With pyrethrum, however, it was not notably effective and with derris it had no value. It is thought that derris and pyrethrum may kill the larvae largely by contact action. The hexahydroxy alcohol, sorbitol, was used only with lead arsenate, with which it was very effective. Other compounds that definitely improved the effectiveness of lead arsenate were sucrose, maize syrup, d-fructose, glycerine and malic acid. Although smaller differences in survival resulted from the use of honey, dextrose and galactose, these compounds appreciably reduced the amount of injury. Molasses, which was used only with nicotine bentonite and thiodiphenylamine, increased the effectiveness of both. Brown sugar and lead arsenate gave excellent results in combination with summer oil, indicating that the presence of the latter does not interfere with the attractiveness of the sugar.

Throughout this study, the data showed that the percentage of superficial injuries was usually markedly reduced by the addition of an attractant to the insecticide. This is a good indication that a larger proportion of the larvae ingested a toxic dose before they ruptured the skin of the apple.

BRUNSON (M. H.). **Mass Liberation of Parasites of the Oriental Fruit Moth for immediate Reduction of Infestation.**—*J. econ. Ent.* **33** no. 2 pp. 346–349, 2 refs. Menasha, Wis., 1940.

The following is substantially the author's summary: To determine whether mass liberations of parasites of *Cydia* (*Grapholitha*) *molesta*, Busck, would reduce fruit infestation, a detailed study was made in 1938 in three peach orchards that had received liberations of *Macrocentrus ancylivorus*, Rohw., and *Microdus* (*Bassus*) *diversus*, Mues., and in two orchards that had received no parasites. These orchards were in New Jersey and Pennsylvania. Parasitism of larvae of the first and second generations was greater in the orchards receiving parasites than in those receiving none, and the infestation of ripe fruit

was less. The results obtained appear to show a definite relation between the percentage of larval parasitism and the number of ripe fruits infested per tree and per acre. Also, it was shown that in different parts of the same general area, different species of parasites predominate.

YETTER jr. (W. P.) & ALLEN (H. W.). **Effect of Larval Parasitization of the Oriental Fruit Moth on Infestation.**—*J. econ. Ent.* **33** no. 2 pp. 349–353, 3 refs. Menasha, Wis., 1940.

The following is substantially the authors' summary: An experiment was carried out in eight peach orchards in New Jersey in 1938 to determine whether any definite correlation between parasitism of the larvae of *Cydia* (*Grapholitha*) *molesta*, Busck, by *Macrocentrus ancylivorus*, Rohw., and subsequent infestation in ripe fruit could be detected. On representative trees, detailed records were made of the first- and second-brood population in infested twigs and immature drops and of the degree of parasitism. At harvest time, counts were made of the infestation of ripe fruit in Elberta or varieties ripening at about the same time. In this series of orchards, there was found to be a definite relationship between the larval parasitism and the infestation in ripe fruit. The records obtained ranged from an infestation of 4·0 per cent., or on an average 16·1 infested fruits per tree, in orchards having average seasonal parasitism of more than 70 per cent., to infestation of 30·4 per cent., or 108·9 infested fruits per tree, in orchards having average seasonal parasitism of less than 60 per cent. The reduction of infestation in orchards having high parasitism was sufficient to be of important commercial value.

DRIGGERS (B. F.). **Oriental Fruit Moth Larval Parasitism as related to Infestation.**—*J. econ. Ent.* **33** no. 2 pp. 353–357. Menasha, Wis., 1940.

The following is substantially the author's summary: A three-year survey of the parasitism of twig-feeding larvae of *Cydia* (*Grapholitha*) *molesta*, Busck, and fruit infestation was made in a number of peach orchards in New Jersey from 1937 to 1939. A high degree of parasitism of the first two broods of larvae was found in the majority of orchards in each of the three years. The principal parasite was *Macrocentrus ancylivorus*, Rohw., in southern New Jersey, and *Glypta rufiscutellaris*, Cress., in northern New Jersey. Fruit infestation in each of the three years was light to moderate on varieties ripening during the Elberta season in the majority of the orchards. No strict correlation was found between either percentage total parasitism or parasitism of the second brood and percentage fruit infestation. A correlation was found between the nature of the planting and the percentage fruit infestation. Orchards in which late ripening varieties were interplanted with early and midseason ripening varieties of peaches showed high fruit infestation counts on the late ripening varieties. Blocks planted with late ripening varieties only showed the lowest infestation of fruit.

The results reported, substantiated by additional observations, can be applied to advantage by peach growers in arranging future plantings. The interplanting of early-, mid- and late-season varieties of peaches should be avoided, as well as the interplanting of peaches and apples.

GLASGOW (H.). **A Plot Arrangement for timing the Applications in a Control Program.**—*J. econ. Ent.* **33** no. 2 pp. 357–361, 2 figs. Menasha, Wis., 1940.

A method is described of investigating the most efficient timing of applications of an effective insecticide by the use of a series of plots, the number depending on the probable complexity of the control programme that is being considered, which are divided into groups that decrease progressively in number until there is a single plot in the final section. In an example given to illustrate the method, 21 plots were used, in addition to control plots, as it was desired to test the effect of applying a spray of lubricating oil against the onion maggot [*Hylemyia antiqua*, Mg.] on any one or more of six different dates. The first application was made to all six plots in group 1, the second to the last five plots in group 1 and to all five in group 2, the third to the last four plots in groups 1 and 2 and to all four in group 3, and this procedure was followed consistently, another plot being omitted from each of the sections already treated and one entire new section being added to the series at each interval, until at the end of the fifth period only one plot in each of the six series received an application. Such a series of tests, which can be adapted readily to any intervals, regular or irregular, that may be chosen for spacing the applications, should provide an accurate answer to almost any question as to timing ; in the instance given, the effect of one or more differently timed sprays on both infestation and yield of onions is clearly demonstrated.

HEADLEE (T. J.). **The Relative Effects on Insect Metabolism of Temperatures derived from Constant and Variable Sources.**—*J. econ. Ent.* **33** no. 2 pp. 361–364, 3 refs. Menasha, Wis., 1940.

Quotations are given from two papers by earlier workers [*R.A.E.*, A **15** 532 ; **16** 642] in which insect development was found to be more rapid at varying than at the intermediate constant temperatures, and the results of a study made by the author with overwintered larvae of the codling moth [*Cydia pomonella*, L.], an account of which was published in 1929, are summarised. The experiment was begun on 15th April 1928, and whereas 21 days were required for maximum emergence at a temperature varying from 50 to 76°F., the same stage was reached at a constant temperature of 63°F. in 13 days. In November 1938, the relative effects of constant and varying temperatures on *Aëdes aegypti*, L., were studied. The mechanism used to regulate the temperatures is briefly described. The days elapsing between hatching and maximum emergence at constant and varying temperatures and (in brackets) the percentages of larvae reaching the adult stage were : 24·5 (17·3) and 23 (32) at 65 and 50–80°F. ; 13 (25·2) and 20 (60) at 75 and 60–90°F. ; and 10 (74) and 28 (2·1) at 85 and 70–100°F.

The cause of the apparent inconsistency of these results is discussed. The characteristic curve of reaction of insects to external factors is sigmoid ; if the factor is temperature, the top and foot curves represent the regions of retardation due to high and low temperatures, respectively. If, therefore, the variable range under examination extends into either of these curves, the speed of metabolism is likely to be reduced, and development to take longer at the variable than at the constant temperature. If the constant is too close to either curve,

retardation is likely to result. The effect of varying and constant temperatures appears to depend, therefore, on where they lie in the temperature scale of the insect or stage concerned.

HAMILTON (C. C.). **Control of the Leaf Roller,** *Platynota flavedana* **Clem. on Roses.**—*J. econ. Ent.* **33** no. 2 pp. 364–368, 9 refs. Menasha, Wis., 1940.

The following is based largely on the author's summary : *Platynota flavedana*, Clem., caused considerable damage to the foliage and buds of roses in greenhouses in Cranbury, New Jersey, in the autumn, winter and spring of 1938–39, but was eventually brought under control by fumigation with nicotine. There is little information on the life-history and food-plants of this Tortricid ; previous records have reported it merely as a general feeder. During the spring and summer months, the life-cycle appeared to require about 5–6 weeks.

Sprays containing pyrethrum extract, which have proved effective against other leaf-rollers attacking greenhouse roses, did not prove satisfactory against *P. flavedana*, as the control was poor and the cost high. Fumigating twice a week at regular intervals with nicotine killed the adults before they laid many eggs. The use of pressure fumigators, which allowed the nicotine fumes to be directed across the beds and under the foliage of the plants, greatly reduced the dosage of nicotine necessary. This treatment gave better control at a lower cost than a spray of pyrethrum and soap.

RICHARDSON (H. H.). **Toxicity Studies of Mixtures of Nicotine and Naphthalene as Fumigants.**—*J. econ. Ent.* **33** no. 2 pp. 368–372, 2 figs., 8 refs. Menasha, Wis., 1940.

The following is the author's summary : Laboratory tests were made on the fumigating action of nicotine and naphthalene and their mixtures on the green peach aphis (*Myzus persicae*, Sulz.) and the greenhouse whitefly (*Trialeurodes vaporariorum*, Westw.). All insects were fumigated off their host plants by an air-flow method, which tended to keep the gas concentration constant in the fumigation flasks during the entire exposure period.

When sub-lethal concentrations (0·006 to 0·19 mg. per l.) of naphthalene were added to a lethal concentration of nicotine (0·0084 mg.), the fumigants appeared compatible, but no increase in toxicity over nicotine alone could be detected against the green peach aphis in half-hour exposures at 25°C. [77°F.]. Naphthalene alone in concentrations up to approximate saturation (0·56 mg. per l.) and at the same exposure had little efficiency. Against the greenhouse whitefly the addition of sub-lethal concentrations of nicotine (0·004–0·006 mg. per l.) to lethal concentrations of naphthalene (approximately 0·56 mg.) increased efficiency very definitely over naphthalene alone in exposures of 15 to 75 minutes (25°C.). The speed with which the whiteflies were paralysed by the mixture was also increased considerably over either naphthalene or nicotine alone. Low and high relative humidity (approximately zero and 75 per cent.) appeared to have little effect on the efficiency of the mixture. The naphthalene-nicotine combination seems worth testing under practical conditions.

Whitcomb (W. D.) & Tomlinson jr. (W. E.). **The Grape Plume Moth.** —*J. econ. Ent.* **33** no. 2 pp. 372–374, 1 fig., 4 refs. Menasha, Wis., 1940.

In recent years, most of the grape vines growing in home gardens in eastern Massachusetts have been attacked by the larvae of *Oxyptilus periscelidactylus*, Fitch, which feed on the foliage, sometimes causing skeletonised areas, web together the leaves of the terminal buds, and occasionally destroy flower buds. Since their feeding is completed early in June, when the plants are still making rapid growth, the injury is scarcely noticeable by mid-summer. The absence of more extensive infestations in commercial vineyards is probably due to pruning and spraying against other pests.

There is one generation in the year in Massachusetts, the winter being passed in the egg stage. The eggs are usually deposited in the small crotch between branches on old canes. The larvae hatch when the buds are swelling, feed for about 30 days and then pupate, usually within the webbed leaf. In 1939, they hatched between 7th and 10th May and pupated between 10th and 15th June. The adults emerged during late June and early July and all oviposition in the insectary occurred between 30th June and 4th July.

The eggs were killed by dormant sprays both in the laboratory and in gardens. In the latter, the sprays were applied at a pressure of about 125 lb. on 21st April when the buds were beginning to swell, and either a 1 per cent. solution of a preparation (Egetol) of sodium dinitro-cresylate or an oil emulsion diluted to contain 3 per cent. actual oil gave satisfactory control without injuring the plants. These results confirmed those of the laboratory experiments, but lime-sulphur concentrate (33° Bé.) diluted with 8 parts of water, which had been effective in the laboratory tests, failed to give control.

Kisliuk jr. (M.). **Some scientific Contributions made at the Port of New York.**—*J. econ. Ent.* **33** no. 2 pp. 374–379, many refs. Menasha, Wis., 1940.

The author points out that plant-quarantine inspections of imported products in the United States have resulted in valuable additions to the data on the world distribution of insect pests and plant diseases, as well as the recording of new food-plants for some of the economic species, the seasons in which infestations occur, and other facts concerning the relationship of insect pests to plants. He suggests that more scientific workers should make use of the information available, and gives a large number of examples of records of insect pests obtained at the port of New York, including many from unexpected food-plants and from new parts of the world.

Nickels (C. B.) & Pierce (W. C.). **Insecticide Tests against the Pecan Nut Casebearer in Texas in 1938.**—*J. econ. Ent.* **33** no. 2 pp. 379–382. Menasha, Wis., 1940.

Spraying experiments for the control of the first generation of *Acrobasis caryae*, Grote, on pecan were carried out in southern Texas in 1938 to determine the effectiveness of single applications of seven spray combinations. The sprays were applied in May, and the insecticides used per 100 U.S. gals. spray were 4 lb. lead arsenate alone, 6 lb. lead arsenate alone or with 1 U.S. gal. summer oil emulsion

(about 80 per cent. oil), 1 lb. soy-bean flour or 1 fl. oz. sulphated alcohol, and 6 lb. natural cryolite (sodium fluoaluminate) alone or with 1 U.S. gal. summer oil emulsion. Zinc sulphate (2 lb. per 100 U.S. gals.) was added to all sprays [*cf. R.A.E.*, A **26** 138]. Lead arsenate at the lower strength gave the least effective reduction in infestation, and cryolite without oil was less effective than the other sprays. All the sprays gave large increases in yield of nuts, but the stronger lead-arsenate sprays gave much greater yields than the weaker one or cryolite alone. No yield figures are recorded for cryolite and oil. As a rule, slightly higher yields resulted from lead arsenate when oil was added to it, but the soy-bean flour and sulphated alcohol seemed to be of no value. At the end of the season, hibernacula were about three times as abundant on control trees as on those that had been sprayed with lead arsenate and oil.

GRAYSON (J. M.). **Control of the European Red Mite with special Reference to Dinitro-o-cyclohexylphenol in dormant Sprays.**—*J. econ. Ent.* **33** no. 2 pp. 385–389, 6 refs. Menasha, Wis., 1940.

The following is substantially the author's summary : The effectiveness of petroleum oil in dormant or delayed-dormant sprays against eggs of *Paratetranychus pilosus*, C. & F., on apple in Virginia was slightly increased by the addition of dinitro-o-cyclohexylphenol. Sprays consisting of 2 per cent. petroleum oil and dinitro-o-cyclohexylphenol in concentrations of not less than 8 oz. per 100 U.S. gals. gave control comparable with that obtained with 3 per cent. petroleum oil alone in most cases. Dinitro-o-cyclohexylphenol, when used as a wettable powder without petroleum oil, was ineffective as an ovicide. Water-gas tar oils and combinations of tar distillate and paraffin wax were ineffective. Sprays applied in December and January were less effective against the eggs of *P. pilosus* than those applied in March or April.

Satisfactory control of an outbreak of *P. pilosus* on apple in West Virginia was obtained in July by the application of a spray of 6 quarts 83 per cent. summer oil emulsion per 100 gals. water.

COON (B. F.) & WAKELAND (C.). **The Repellency of Pyrethrin Dusts to the Beet Leafhopper on Tomatoes.**—*J. econ. Ent.* **33** no. 2 pp. 389–393, 3 refs. Menasha, Wis., 1940.

The following is based on the authors' summary of experiments in 1938 on the use of pyrethrum dusts as repellents against *Eutettix tenellus*, Baker, in Idaho, where this leafhopper is of great importance as the vector of western yellow tomato blight, a disease caused by the virus that also causes curly-top of beet : In greenhouse experiments, diatomaceous earth was partially effective in preventing the feeding of adults of *E. tenellus* on tomatos. Dusts consisting of diatomaceous earth with either Pyrocide 20 (a liquid pyrethrum atomised into the dust) or Dry Pyrocide (a standardised, stabilised pyrethrum dust) entirely prevented feeding for 72 and 96 hours, when applied at the rate of 2·8 gm. per plant. The minimum effective pyrethrin content for both the dusts in the greenhouse was 0·23 per cent. Under field conditions, the application of about 31 lb. per acre of a dust of diatomaceous earth with either Dry Pyrocide or Pyrocide 20 (0·27 per cent. pyrethrins) did not entirely prevent the feeding of *E. tenellus* on tomatos, but reduced it to some extent. The dust containing Dry

Pyrocide appeared to be the more effective. The application of dusts to tomato plants did not apparently hinder growth or prevent pollination or the setting of fruit.

Osburn (M. R.). **Costs of Control Measures for the Citrus Rust Mite.**—*J. econ. Ent.* **33** no. 2 pp. 393–396. Menasha, Wis., 1940.

The following is taken from the author's summary : Costs of sulphur spray and dust treatments for the control of the rust mite, *Phyllocoptruta* (*Phyllocoptes*) *oleivorus*, Ashm., on *Citrus* in Florida have been calculated from data collected over a period of four years from experimental plots in six orange groves.

In general, the cost of control by dusting with sulphur was rather less than half that of control by the cheapest spray programme. The addition of wettable sulphurs to lime-sulphur reduced the number of applications required in a season, but during a heavy rust-mite year on Valencia trees a schedule employing lime-sulphur alone was cheaper, although an extra application was required. Generally, the addition of 5 lb. wettable sulphur to 100 U.S. gals. lime-sulphur solution gave as good protection as the addition of 10 lb. Dry lime-sulphur sprays were more costly than most of the other comparable spray treatments. Experimental procedure with all the above treatments gave commercial control and prevented russetting of fruit equally well. Controlling *P. oleivorus* increased fruit production, resulting in a profitable return.

Roark (R. C.). **Definition of the Word "Rotenoid."**—*J. econ. Ent.* **33** no. 2 p. 416. Menasha, Wis., 1940.

The author points out that different workers have given different definitions of the word rotenoid, which is likely to come into use in the literature of applied entomology as a designation for substances allied to rotenone. He therefore suggests the following definition : A rotenoid is a substance other than rotenone, but structurally related to it, naturally occurring in leguminous fish-poison plants (*e.g. Derris, Lonchocarpus, Mundulea* and *Tephrosia*). Rotenoids may be quantitatively determined by the Meyer (*Rec. trav. chim.* **55** pp. 954–958, 1936) colour test. Examples of rotenoids are laevodeguelin, laevo-alpha-toxicarol, sumatrol and elliptone.

Brooks (J. W.) & Allen (T. C.). **Combined Derris-Nicotine Dusts for Cabbage Insects.**—*J. econ. Ent.* **33** no. 2 pp. 416–417. Menasha, Wis., 1940.

In south-eastern Wisconsin, the cabbage aphis [*Brevicoryne brassicae*, L.] and caterpillars frequently occur together on cabbage, and an insecticide adapted to control both of them is desirable. Dusts containing derris or other rotenone-bearing material have been among the most satisfactory organic insecticides for the control of the caterpillars, whereas nicotine dusts are generally considered to give the most satisfactory control of the Aphid. A combination of these insecticides should therefore be effective against both pests, but they are not both compatible with any one of the diluents ordinarily used. The authors have shown that alkaline dust diluents weaken the insecticidal effect of derris [*R.A.E.*, A **25** 560], but found in subsequent tests that a mixture of sulphur and an alkaline dust did not affect it, although the mixture remained alkaline. It is known that a mixture of sulphur

and hydrated lime causes a rapid production of nicotine from nicotine sulphate [*cf.* **11** 360]. Preliminary tests of various combinations of these materials carried out in the field in 1938 indicated that a dust of 25 lb. derris and 5 lb. nicotine sulphate with 37·5 lb. sulphur and 37·5 lb. hydrated lime as diluents was approximately as effective against the Aphid as one of 94 lb. hydrated lime and 6 lb. nicotine sulphate, and gave excellent control of cabbage caterpillars ; it also gave fair results against the pea aphis [*Macrosiphum onobrychis*, Boy.]. Derris dusts with the same and other carriers but without the nicotine sulphate appeared to be ineffective in controlling *B. brassicae*.

Hartzell (A.) & McKenna (G. F.). **β, β′-Dichloroethyl Ether for the Control of Gladiolus Thrips.**—*J. econ. Ent.* **33** no. 2 p. 417, 2 refs. Menasha, Wis., 1940.

During August 1938, sprays of 0·1 per cent. pyrethrum resins (0·02 per cent. pyrethrins), a saturated solution of β, β′-dichloroethyl ether (8·3 cc. per litre), and a combination of both were applied to gladiolus plants growing in field plots in New York for the control of *Taeniothrips simplex*, Morison. A sulphated alcohol (0·5 per cent. Tergitol 7 penetrant) was used in all three sprays as a wetting agent. Counts of living and dead nymphs and adults, made 24 hours later, showed percentage mortalities of 31–88 for the pyrethrum resins, 78·1 for the dichloroethyl ether and 81·3–95·6 for the combined spray. Two varieties of gladiolus showed no injury one week after repeated applications of these sprays but severe yellowing of the foliage two weeks after.

During the winter, the same sprays at the same concentrations were applied to gladiolus plants in the greenhouse. Injury occurred on the more delicate varieties when the dichloroethyl ether was used, while with the two varieties previously tested the injury was again delayed. It is possible that injury may be avoided by using a lower concentration of the sulphated alcohol.

Knowlton (G. F.). **The Bee Loss Situation in Utah.**—*J. econ. Ent.* **33** no. 2 p. 418. Menasha, Wis., 1940.

Losses of bees have been reported periodically in Utah for many years and have been attributed to various causes, including orchard spraying in early spring, the control of sugar-beet webworm [*Loxostege sticticalis*, L.] with Paris green, which the bees are supposed to drink with the water in sprayed fields during the morning, and the use of poisoned bait for the control of grasshoppers. Arsenic has been present in or on most bees analysed during recent years, and it was found in 1939 in samples of bees from one county in which losses were attributed to Paris green, but no copper was present. The fact that bees may accumulate arsenic on their bodies when visiting sprayed or dusted plants makes it difficult to determine whether particular samples have been killed by the arsenical found to be present.

Early reports that heavy losses of bees in Utah in 1939 were due to poisoning from grasshopper bait were not confirmed, and the author points out that relatively little poison bait was used in the State in that year. Investigations conducted by him and W. P. Nye showed that, between 1st August and 15th September, bees were not attracted to grasshopper bait and numerous combinations of bait materials, even when they were made readily available to them and applied at a

rate much heavier than is recommended against grasshoppers, but it is possible that bees might work over any exposed or carelessly applied poisoned bait at times of serious pollen or nectar shortage.

BACK (E. A.). **A new Parasite of** *Anthrenus vorax* **Waterhouse.**—*Proc. ent. Soc. Wash.* **42** no. 5 pp. 110–113, 6 figs., 2 refs. Washington, D.C., 1940.

Larvae of the carpet beetle, *Anthrenus vorax*, Waterh., parasitised by a Bethylid subsequently described by C. F. W. Muesebeck as *Laelius voracis*, sp. n. [*Proc. biol. Soc. Wash.* **52** pp. 171–176, 1939], were found in May and June 1939 in widely separated storage houses in Washington, D.C., and the parasite has since established itself in the laboratory through the introduction of host larvae with infested rugs, furs and clothing, and has made difficult the rearing of *A. vorax*. In the storage rooms of the Department of Agriculture, active cultures of *A. vorax* maintained in brushes for 2–3 years were completely destroyed by it in the summer of 1939. A single mature larva of the beetle harbours 1–4 larvae of the parasite, which leave the host through exit holes made on the ventral side at the junction of the abdomen and thorax. They pupate in white cocoons, which are usually spun beneath or beside the host, and sometimes in cast larval skins if these are close to it. This is the first instance of parasitism of *A. vorax* in Washington since its discovery there in 1915.

MUESEBECK (C. F. W.). **Two new Hymenopterous Parasites of Sugar-cane Borers in India.**—*Proc. ent. Soc. Wash.* **42** no. 6 pp. 120–122. Washington, D.C., 1940.

The new species described are the Braconid, *Rhaconotus caulicola*, and the Bethylid, *Goniozus indicus*. Both are parasites of larvae of *Scirpophaga* in sugar-cane [*cf. R.A.E.*, A **28** 330] and of *Chilo* at Coimbatore (Madras), while *G. indicus* has also been reared from *Diatraea venosata*, Wlk., in this locality and from *Scirpophaga* in northern India. *Trissomalus fulvicornis*, Rohw., the type series of which was reared from *Argyroploce illepida*, Btlr. (*Cryptophlebia carpophaga*, Wlsm.) in India, is referred to the genus *Goniozus*, and characters distinguishing *G. indicus* from it are given.

DAVIS (A. C.). **Notes on** *Dinapate wrightii* **Horn (Coleoptera : Bostrichidae).**—*Proc. ent. Soc. Wash.* **42** no. 6 pp. 129–134, 9 refs. Washington, D.C., 1940.

A brief survey is given of the literature on the Bostrychid, *Dinapate wrighti*, Horn [*cf. R.A.E.*, A **27** 569, etc.], from which it is concluded that it is becoming more widely distributed and abundant on *Washingtonia filifera* in California. There is good authority for a record that it has also attacked date palms in the Coachella Valley. It seems probable that the eggs are laid in the burrows in the bud of *Washingtonia*, as well as under the fibres of the leaf bases, as in most of the fallen palms examined by the author the portion near the crown was reduced to coarse powder, whereas the part further down remained fairly intact. The author records his observations in May and June 1928 on larvae, pupae and adults found in fallen logs, describes the pupae and adults and gives notes on the behaviour of the latter in captivity.

WATERSTON (J. M.). **Report of the Plant Pathologist, 1939.**—13 pp. [Hamilton] Bermuda, 1940.

One section of this report on insect pests and work done on them in Bermuda during 1939 is devoted to an account of the action taken to prevent the introduction of *Popillia japonica*, Newm. [*R.A.E.*, A **28** 496].

When timber infested by *Calotermes* (*Kalotermes*) *brevis*, Wlk., was treated with a proprietary preservative, the termites were destroyed and there was no re-infestation within a period of a year. Timber treated under pressure with a coal-tar preservative and used in the construction of trestle bridges has remained free from infestation by *C.* (*K.*) *approximatus*, Say [*sic* ? Snyder] for 10 years. This species has severely attacked 12–20 year old electric-light and telephone poles made of *Juniperus bermudiana* [*cf.* **28** 25] and also cross-pieces of the same wood and of *Pinus palustris*, but 20-year-old poles of *Eperua falcata* were only slightly infested, and cross-pieces of *Nectandra rodioei* were very resistant ; pins for supporting insulators made of *Hymenaea courbaril* are susceptible to attack and are being replaced by metal ones.

Dry weather during the first half of the year favoured *Gnorimoschema* (*Phthorimaea*) *operculella*, Zell., which seriously damaged potato tubers stored at ordinary temperatures during the summer ; in some cases the losses amounted to nearly 75 per cent. Other food-plants are tomato, which therefore should not be interplanted with potato, egg-plant [*Solanum melongena*] and sweet pepper [*Capsicum*]. Methods of reducing infestation in the field are briefly reviewed [**27** 389, etc.] ; favourable conditions for infestation are provided by the light porous nature of the soil, which should be cultivated thoroughly, and by neglect of crop rotation. Storerooms should be repaired, well lime-washed or fumigated, and made as insect-proof as possible before each harvest ; small quantities of tubers can be stored under a layer of dry soil or sand 4 ins. thick, where sound barrels are unobtainable. Uninfested potatoes dusted with pyrethrum or naphthalene and stored in barrels at ordinary summer temperatures remained free from infestation for over 100 days, but there was considerable depreciation owing to water loss. Promptly harvested tubers were successfully stored through the summer in an insect-proof cellar storehouse in which the humidity was controlled by watering the earthen floor. Fumigation with methyl bromide is stated to be the best treatment for infested tubers. All stages of the pest are effectively destroyed by subjecting the tubers to a temperature of 36–40°F. for 15 days, but this treatment is economically impracticable under local conditions.

In experiments on insecticides, *Laphygma* (*Xylomyges*) *eridania*, Cram., was controlled on potato by a calcium arsenate dust, and a bran bait containing Paris green destroyed larvae of *Feltia subterranea*, F., which migrated from grass and attacked cabbage and carrot seedlings, and the Myriapod, *Julus moreleti*, Lucas, which sometimes attacks potato tubers in the ground. A particularly severe outbreak of the rosette virus disease of lilies was experienced as a result of increased populations of the vector, *Aphis gossypii*, Glov., in which even mature plants and early autumn plantings were affected. Larvae of *Ligyrus tumulosus*, Burm., caused considerable damage to lily bulbs, particularly those growing in fields that had been under grass and weeds before planting ; ploughing in a previous crop of cowpeas as green manure is recommended as a means of reducing damage.

Other pests observed during the year included *Euscepes postfasciatus*, Fairm., in sweet potato tubers ; *Phylloxera vitifoliae*, Fitch, on isolated vines in two districts in July ; the Anobiid, *Oligomerus obtusus*, Lec., larvae and adults of which damaged the woodwork of a house ; and the Scolytid, *Coccotrypes dactyliperda*, F., which attacked buttons imported from England and which has also been recorded in association with fallen fruits of Bermuda palmetto [*Sabal bermudiana*]. *Macrodactylus subspinosus*, F., which is a serious pest of grape-vines in the United States, was intercepted on cut roses from that country.

WILLE (J. E.). **La conservación de los granos y los insectos que atacan a los granos y semillas almacenadas.** [The Preservation of Grain and the Insects attacking stored Grain and Seed.]—*Circ. Estac. exp. agríc. Minist. Fom. Peru* no. 53, 23 pp., 20 pls. Lima, 1940.

Brief accounts are given of the bionomics of the more important insects that infest stored grain, seeds and other products in Peru [*cf. R.A.E.*, A **22** 187]. They include an undescribed Bruchid in the seeds of lucerne. It is restricted to Peru, and infestation begins in the field. The chief method recommended for control of pests of stored grain is fumigation with carbon bisulphide.

The Storage of Foodstuffs in the Colonial Empire.—*Bull. Imp. Inst.* **38** no. 2 pp. 163–180, 10 refs. London, 1940.

This memorandum, circulated to Colonial Governments, comprises a summary of available information on the storage of foodstuffs in the British Colonies, compiled with a view to improving existing practices as considerable losses result from faulty storage. The general requirements as regards the moisture content of grain to avoid heating and insect attack during storage are discussed, and the various methods used by the peasantry in tropical and sub-tropical countries for the bulk storage of grain are described, together with notes on the storage of products in bags in specially constructed stores. A section contains very brief descriptions of the commoner insect pests of stored grain, flour and pulses, the manner in which infestation takes place, precautions to be taken against it, and measures for control.

SAKIMURA (K.). **Evidence for the Identity of the Yellow-spot Virus with the Spotted-wilt Virus : Experiments with the Vector, *Thrips tabaci*.**—*Phytopathology* **30** no. 4 pp. 281–299, 4 figs., 49 refs. Lancaster, Pa., 1940.

In June 1937, an outbreak of a virus disease with symptoms indistinguishable from those of spotted wilt was observed in tomatos in a small field on Oahu, Hawaii. *Emilia sonchifolia* was abundant in the field, and random samples of this weed showed high populations of *Thrips tabaci*, Lind. (6·81 per plant) and incidence of virus infection (79·8 per cent.), whereas populations of the thrips on tomato were negligible. The symptoms in *Emilia* were indistinguishable from those of pineapple yellow spot [*cf. R.A.E.*, A **28** 381, etc.], and in experiments in which examples of *T. tabaci* from *Emilia* were transferred to 12 healthy seedlings of *Emilia* and 12 of pineapple, 10 of each developed symptoms of yellow spot.

References in the literature to the distribution, host range and possible identity of the viruses of spotted wilt and yellow spot are reviewed; the latter has recently been observed in pineapple in Queensland and South Africa, where the virus of spotted wilt is well established. In investigations in Hawaii, G. K. Parris showed that the virus of yellow spot was readily transmitted by the carborundum method to tomato, *Emilia* and potato, and he concluded that the tomato disease observed on Oahu was caused by the yellow-spot virus. In the author's experiments, the technique of which is described in detail, adults from uninfected nymphs of *T. tabaci* that were allowed to feed on *Emilia* infected with yellow spot or infected *Emilia* from the tomato field transmitted the virus to healthy *Emilia*, pineapple and tomato and from tomato back to *Emilia*, and the symptoms produced by the virus from the two sources were indistinguishable. Those produced in tomato, which are described, were identical with those on the naturally infected tomatos, and also with those of spotted wilt. Tomato was an unsuitable food-plant for *T. tabaci* under experimental conditions. In further experiments, young nymphs of *T. tabaci* were allowed to feed on the infected fruits or twigs of naturally infected tomato plants or on twigs showing fresh symptoms from plants grafted with field-infected scions. The adults resulting from those fed on the green fruits and on the twigs from grafted plants transmitted the virus to *Emilia*, pineapple and tomato, and adults from those from other twigs showing fresh symptoms to *Emilia*, but transmission was not effected by thrips from the ripe fruits or twigs with aged symptoms. The symptoms produced in the three plants were indistinguishable from those of the plants infected with the virus of yellow spot in the previous tests.

It is concluded that the causal agent of the Hawaiian disease in tomato is the long-established virus of yellow spot, and that the symptoms of yellow spot of tomato are identical with those of spotted wilt. Strong evidence that spotted wilt in other parts of the world is caused by the same virus was afforded by experiments in which the virus of yellow spot was also transmitted by *T. tabaci* to spinach, broad bean, celery, potato, egg-plant [*Solanum melongena*], bell pepper [*Capsicum*], tobacco, *Nicotiana glutinosa*, *Datura stramonium*, petunia, chicory, endive and lettuce, all of which are known to be susceptible to the virus of spotted wilt, and from them back to *Emilia*. The symptoms were identical with those of the spotted-wilt virus on all plants for which published descriptions of the latter are available, and the lengths of the latent periods within the respective plants, which are shown in a table, were generally analogous. The symptoms in spinach, *S. melongena*, *Capsicum*, chicory and endive are described, and those in the other plants are compared in a table. Beet, Swiss chard, cabbage and New Zealand spinach (*Tetragonia expansa*), which are not susceptible to spotted wilt, were not infected by the virus of yellow spot. Cauliflower was the only plant susceptible to spotted wilt that did not become infected with the yellow-spot virus, and this failure is attributed to the peculiar conditions under which the experiment was performed.

Among the plants that were not susceptible to yellow spot was *Commelina nudiflora*, which is affected by a mosaic disease in Hawaii [**25** 516]. In experiments, the virus of this disease was not transmitted by *T. tabaci* or that of yellow spot by *Aphis gossypii*, Glov., which is

one of the vectors of the mosaic of *Commelina* [*loc. cit.*], and the latter was not transmitted by the Aphid to *Emilia*.

In a foot-note (p. 282), the author states that he has been informed by A. S. Costa that the virus of vira-cabeça of tobacco and tomato in Brazil [**28** 281] has been shown to be identical with that of spotted wilt, and that the species of *Frankliniella* that transmits it [*loc. cit.*] is possibly *F. paucispinosa*, Moult., which is the vector of corcova of tobacco and tomato in Argentine [**26** 581].

Entomological Problems.—*Rep. Coun. sci. industr. Res. Aust.* **13** (1938–39) pp. 15–22. Canberra [1940]. **Weeds Investigations.**—*T.c.* pp. 22–26.

Many second- and third-generation larvae of *Cydia molesta*, Busck, died in the Goulburn Valley, Victoria, as the result of drought during January and February 1939, which rendered the peach twigs unsuitable for penetration, and when populations increased after the drought, the resulting larvae attacked quinces, which were the only suitable fruits then available. No moths were observed in the Murrumbidgee irrigated area in New South Wales in the spring of 1938 [*cf. R.A.E.*, A **27** 544], and trapping was therefore discontinued. It is considered that there is little prospect of controlling *C. molesta* by means of sprays, which have completely failed under field conditions [*cf. loc. cit.*], and attention is therefore being concentrated in establishing the imported parasite, *Macrocentrus ancylivorous*, Rohw., which was recovered in fair numbers from several orchards at the end of the previous season [*loc. cit.*], but which was prevented by the hot, dry weather from further increase during 1938–39.

Analysis of data regarding recent outbreaks of *Chortoicetes terminifera*, Wlk., in New South Wales established that hatching and the subsequent development of this locust occur only where the mean Meyer ratio, obtained by dividing the mean monthly precipitation by the mean monthly saturation deficit, expressed in the same units, reaches a value of about 2 during the period of development. Development is most rapid under conditions of high temperature and adequate moisture, and is retarded if either is deficient. Three generations occur during the year only in districts where conditions are favourable throughout the season, and since the occurrence of three generations is one of the factors concerned in the initiation of outbreaks, districts where outbreaks are likely to occur can be mapped. Swarms generally move into areas of higher humidity, and this is probably connected in some way with the direction of the prevailing wind. Correlation of past outbreaks with climatic cycles indicated a tendency for them to reach a maximum in years of exceptional summer rainfall, and to be slight or absent when rainfall was low.

A liberation in Victoria of adults of *Hexamera*, imported from New Zealand for the control of *Oncopera*, in a plot artificially infested with larvae [*cf.* **27** 545] gave the most promising results of any yet made ; adult Tachinids were still active a fortnight after release. Experiments on the control of *Halotydeus destructor*, Tucker, in Western Australia confirmed that the beneficial effects of clean fallowing are only temporary [**27** 545]. Some evidence was obtained of the value of heavy grazing in late autumn and winter and of increased susceptibility to attack among oats after dressings of sulphate of ammonia ; the presence of cape weed [*Cryptostemma calendulaceum*] appears to favour

the development of the mite [*cf.* **26** 150]. In tests with 15 strains of subterranean clover [*Trifolium subterraneum*], two late, one mid-season and two early strains appeared to sustain less damage than the others. Observations on the survival of the mite during the hot dry summer months showed that at this period the eggs have especially thick and resistant walls, and are enclosed within the dead bodies of the parents.

The destruction of many small and medium sized boree [*Acacia*] trees, previously attributed to defoliation by larvae of *Ochrogaster contraria*, Wlk., was shown to be due to infestation of the roots by Longicorn larvae. Parasites and predators of the immature stages of *O. contraria* are numerous and exert fairly effective control in the field ; the removal of egg bags by hand in December, when they are small and non-irritant, is a simple and effective method of control. Several liberations of *Angitia fenestralis*, Hlmgr., and *A. cerophaga*, Grav., reared from a stock of about 1,000 cocoons imported from New Zealand, were made against *Plutella maculipennis*, Curt., on cabbage in New South Wales, Victoria and South Australia. *Bruchus pisorum*, L., is a serious pest of garden and field peas in Western Australia ; it is proposed to import the parasite, *Triaspis thoracicus*, Curt., for its control.

In previous tests of insecticides on mound colonies of *Eutermes exitiosus*, Hill, arsenicals, especially white arsenic, gave the best result [*cf.* **23** 398 ; **24** 378], but in most cases of termite attack on buildings and timber structures it is difficult to locate the nest and treatment must be confined to the working galleries. Field and laboratory experiments demonstrated that soil termites can be destroyed by the introduction into these galleries of small quantities of poison dust, which is then disseminated throughout the colony by the termites. In trials with chlorinated naphthalenes, which appear likely to be of value for the treatment of manufactured building materials, such as fibre boards, and of fabric used for covering cables, etc., their protective value appeared to increase with the number of substituted chlorine atoms, penta-chlor compounds being appreciably more effective than di-chlor compounds. Attempts to rear several termites, including *Coptotermes acinaciformis*, Frogg., *Rhinotermes intermedius*, Brauer, and *Porotermes adamsoni*, Frogg., in the laboratory met with less difficulty than had been anticipated. When founding a colony, even those species that feed on sound wood showed a marked preference for decaying wood, and, in general, even soil-dwelling forms were unable to find wood that was completely buried in the soil ; none survived when the relative humidity was as low as 80 per cent.

A strong colony of *Aphelinus flavus*, Wlk., was reared in the insectary from a stock obtained from England, for liberation against *Myzocallis annulata*, Htg., on oak [*Quercus robur*], but since this Aphelinid was discovered in the field in the Canberra district during the year, and it also occurs, together with another parasite, *Trioxys aceris*, Hal. [*cf.* **28** 441] in Tasmania, no further parasites of the Aphid will be imported from England. Small collections of *Habrolepis dalmanni*, Westw., which has become established as a parasite of *Asterolecanium variolosum*, Ratz., on oak in Canberra following liberations during 1937–38 [**27** 546], were dispatched to Victoria and New South Wales.

The best control of *Technomyrmex detorquens*, Wlk. (*albipes*, F. Sm.) in houses was given by a sugar solution containing 0·06 per cent. sodium arsenite, and this was also effective against the introduced ant,

Tapinoma melanocephalum, F., which has become a pest in some districts. The concentration of poison was not high enough to impair the attractiveness of the bait, and the workers were not killed until they had returned to the nest and had had an opportunity of distributing it there.

The second section includes notes on insects introduced or suitable for introduction for the control of noxious weeds [*cf.* **27** 546]. Of those that attack St. John's wort (*Hypericum perforatum*), *Chrysomela* (*Chrysolina*) *geminata*, Payk., which was imported from France, is considered to have good prospects of survival, since it aestivates during the dry hot summer and breeds during autumn, winter and spring. Tests showed that this Chrysomelid was harmless to economic plants, and it was released in small numbers, but was destroyed by bush fires in January. Larvae of *Anaitis plagiata*, L., were released in March 1939 but do not appear to have survived; in previous liberations they were destroyed by ants [*cf.* **27** 282], and if the present attempt is unsuccessful, no further shipments of this Geometrid will be made. Roots containing larvae of *Agrilus hyperici*, Crtz., were received from southern France, and adults reared from them were to be liberated in the spring of 1939. Attempts to import larvae of the Cecidomyiid, *Zeuxidiplosis giardi*, Kieff. (*giardiana*, Kieff.), in galls on living plants were unsuccessful.

Burrs of *Xanthium pungens* infested with larvae of *Euaresta aequalis*, Lw., were imported from the United States, and the resulting adults liberated in Queensland. In some districts, adults were bred from burrs on which liberations were made during the previous year. *Tyria jacobaeae*, L., has failed to become established on *Senecio jacobaea*, chiefly owing to attack by *Harpobittacus* sp. [**26** 450].

Pescott (R. T. M.). **The Potato Moth attacks Tomatoes.**—*J. Dep. Agric. Vict.* **38** pt. 5 p. 236, 1 fig. Melbourne, 1940.

Extensive damage to the fruits of tomato by *Gnorimoschema* (*Phthorimaea*) *operculella*, Zell., occurred in April 1940 in the Doncaster and Bendigo districts of Victoria, resulting in losses of up to 60 per cent. of the crop. This Tineid feeds on a number of solanaceous plants but such extensive damage to tomatos has not previously been recorded in Victoria. The fruits are chiefly attacked at the stem end, the larvae entering under cover of the calyx. A small amount of surface feeding occurs in this sheltered position before the flesh of the fruit is entered, but there is little evidence of infestation until the fruit is cut. In the Doncaster district, tunnelling in the stems and a certain amount of mining in the leaves also occurred. Although the infestation was probably favoured by the prevailing dry weather conditions, tomato growers should keep a careful watch for this pest in future crops. The control measure suggested is dusting the fruits as soon as they form with a 50 per cent. lead arsenate dust, applied at weekly intervals for a month.

McCarthy (T.). **Our Grasshopper Problem—small compared with other Countries.**—*Agric. Gaz. N.S.W.* **51** pts. 4 & 5 pp. 177-180, 190–192, 245–249, 263, 8 figs. Sydney, 1940.

McCarthy (T.). **The Grasshopper Pest.**—*J. Dep. Agric. Vict.* **38** pt. 6 pp. 275–284, 294, 12 figs. Melbourne, 1940.

These are two brief and substantially identical reports on the author's visit in 1939 to North America and South Africa, to investigate the

problems of locust and grasshopper control. The organisation of research and control measures in Canada [*cf. R.A.E.*, A **27** 476, 477], the United States [**26** 686 ; **27** 76, 139], and the Union of South Africa [**26** 684 ; **28** 331] are described. In all the countries visited, the use of poison bait is the standard method of control, and it is suggested that machines for mixing and spreading the bait, such as are used in the United States, should be adopted in New South Wales, and experiments should be made on the elimination of molasses and the inclusion of sawdust in the proportion of three parts to one of bran, in the baits used against *Chortoicetes terminifera*, Wlk. It is also desirable to survey the areas suitable for breeding of this species in New South Wales, and to use ecological methods of control on the lines adopted in North America, such as restoration of grassland, planting of suitable bushes or cultivation at the appropriate season, to render lands adjoining the permanent breeding areas unsuitable for oviposition. Finally, a study should be made of overgrazing as a factor in locust abundance.

Insect Pests and their Control.—*Agric. Gaz. N.S.W.* **51** pt. 5 pp. 269–272, 6 figs., 3 refs. Sydney, 1940. *T.c.* no. 6 pp. 324–326, 346, 4 figs.

The first of these parts of a series on insect pests in New South Wales [*cf. R.A.E.*, A **28** 606] includes notes on the life-history of *Eurytoma fellis*, Gir., and the injury it causes to *Citrus* [*cf.* **22** 251 ; **25** 47]. The systematic cutting out and burning of the galls during the winter is recommended as a means of control ; all galls should be removed by the end of August. In some seasons the Aphid, *Myzus persicae*, Sulz., becomes a serious pest of peach during the spring and early summer. A tar-distillate spray, applied at a concentration of 1 : 35 while the trees are completely dormant and after the last overwintering eggs have been laid, prevents any hatching in the spring. A higher concentration may injure the buds. An adult female of *Acrosternum hilare*, Say, was observed on passion vines [*Passiflora edulis*] near Sydney in the late winter of 1938, but no further examples of this Pentatomid could be found there subsequently. It is widespread in the United States, where it feeds on a considerable number of plants [*cf.* **26** 127]. Three specimens of the light-coloured variety (*simpsoni*, Busck [*cf.* **28** 486]) were found among thousands of adults of *Cydia pomonella*, L., reared for life-history studies.

In the second part, attention is drawn to the occurrence of *Aonidiella citrina*, Coq., on *Citrus* in coastal districts, where it is known to have been present for a number of years. Its habits differ from those of *A. aurantii*, Mask., to which it is closely allied, in that it almost invariably infests the leaves and fruits only, while the latter infests the twigs as well. Both species occur intermixed on green fruits.

Speyer (E. R.), Read (W. H.) & Orchard (O. B.). **Animal Pests.**—*Rep. exp. Res. Sta. Cheshunt* **25** (1939) pp. 39–44. Cheshunt, Herts., 1940.

An account is given of work on pests of plants under glass carried out at Cheshunt Research Station in 1939. Leaves of broccoli were attacked by larvae of *Polia oleracea*, L., after clearance of the tomato crop in October, but adults of *Plutella maculipennis*, Curt., that emerged from cocoons introduced on these plants did not appear to

deposit eggs. Foliage of broad beans, especially round the growing point, suffered severe injury from the larvae of *Brotolomia meticulosa*, L., during the autumn, but a dust of cryolite and powdered pumice (1 : 4) gave promising results as a stomach poison against them. Adults of *Pieris rapae*, L., entered a house planted with cauliflower and oviposited on the foliage of young plants, which were severely injured by the larvae in October. Sprays containing powdered derris or *Lonchocarpus* effectively protected cauliflower and broccoli against *Polia oleracea* and *Mamestra brassicae*, L. ; their action was deterrent rather than toxic, but larvae of *Pieris rapae* were killed by contact. Proprietary derris powders containing spreaders were applied at the rate of 1 lb. to 20 gals. water, while *Lonchocarpus* was used at a strength of 1 lb. to 40 gals. water, with 4 lb. soft soap or 3–4 fl. oz. Agral. These spreaders wetted the foliage better than did saponin, sulphonated lorol or casein.

Macrosiphum solanifolii, Ashm. (*gei*, auct.) caused severe injury to broad beans in heated glasshouses, but infestation of French beans was less severe. Winged females ceased to appear in late autumn, and only apterous forms occurred during the winter. *Brevicoryne brassicae*, L., was introduced on broccoli and caused some injury during September, but almost disappeared later as a result of parasitism by Braconids and probably also of low temperatures. *Myzus persicae*, Sulz., bred to an alarming extent and gave rise to winged forms on lettuce and cauliflower during the winter months, after a few individuals had been introduced into a well-heated greenhouse. It made little progress at low temperatures. *M. persicae* and *M. hieracii*, Kalt., are the two Aphids most generally associated with injury to lettuce during the autumn and winter. Fumigation with hydrocyanic acid gas by the pot method, using 0·2 oz. sodium cyanide per 1,000 cu. ft., did not destroy *Macrosiphum solanifolii* on broad beans at temperatures below 54°F., while fumigations at temperatures between 52 and 60°F. with proprietary cyanide powders also failed to kill this Aphid on French beans and *Myzus persicae* on lettuce, although they destroyed adults of the whitefly [*Trialeurodes vaporariorum*, Westw.]. Pyrethrum powder, applied to lettuce severely infested by *M. persicae*, killed practically all the Aphids within 24 hours, except for a small number in the hearts, and also gave an estimated mortality of 50–60 per cent. of *Macrosiphum solanifolii* on broad beans ; a proprietary dust containing 5 per cent. nicotine gave a percentage mortality of only 20.

Paradichlorobenzene applied to the dibbed holes before tomatos were planted out proved harmful to the plants at the concentration required to repel wireworms. Carbon bisulphide emulsions, applied under laboratory conditions at the equivalent of 15 oz. CS_2 per square yard, killed wireworms but were very injurious to young plants. Attacks by Mycetophilids on the roots of cucumber were not so severe or widespread as in previous years, but investigations on various soil insecticides were continued, and solutions of dichlorodiethyl ether were highly toxic to the larvae in preliminary small-scale trials late in the year.

On 15th February, adult females of the rose thrips (*Thrips fuscipennis*, Hal.), which had evidently been hibernating in a wooden partition, were observed on young shoots [*cf. R.A.E.*, A **28** 133]. Only a few contained eggs, and these were in early stages of development, which indicates that a considerable time must elapse between emergence from hibernation and oviposition. It was established

that applications of pyrethrum powder could be relied upon to exterminate the thrips in a short time, provided that they were begun in early spring and in the absence of bright daylight. *T. fuscipennis* was recorded as breeding and causing extensive yellow patches on strawberry fruits in Bedfordshire during May. *Thrips tabaci*, Lind., bred extensively on the foliage of French beans at Cheshunt during November and December, but caused no material injury to the crop; as fumigation with hydrocyanic acid gas was ineffective, dusting with pyrethrum followed by distribution of grade 16 naphthalene after harvesting are recommended for control. Fumigation with tetrachlorethane in a glasshouse of 1,000 cu. ft. capacity that had a maximum day temperature of 77°F. and a minimum temperature of 53°F. and was kept closed for 5 days after a pint of the liquid had been poured on the path proved ineffective against larvae of *Tortrix pronubana*, Hb., on carnation, geranium and *Cyclamen*. Tomato plants from Guernsey, slightly infested with larvae of *T. pronubana*, were received in January; the resulting adults emerged in March. Some larvae reared on *Cyclamen* invaded a young tomato plant and destroyed the foliage. Tests indicated that this Tortricid can be controlled on various plants by the lead-arsenate spray previously recommended [**28** 134], provided that the foliage is thoroughly wetted.

CALLAN (E. McC.). **"Witches' Brooms" on the Cricket-bat and other Willows.**—*Forestry* **14** no. 1 pp. 22–26, 6 refs. London, 1940.

A survey was carried out in January–April 1937 in 12 counties in England on the occurrence of "witches' brooms" on willows; these galls, which usually consist in a distortion of the female flower buds, are attributed to *Eriophyes triradiatus*, Nal. This mite is apparently only found when the gall is in its incipient stage, and so far as the author is aware, the mite itself has not been observed in Britain. Affected trees were more abundant in south-eastern and central England than further north. A list is given of the localities in which observations were made, showing the species of willows examined and the abundance of galls. *Salix fragilis* was the most severely affected, and *S. alba* the least so. Others on which galls were observed were *S. viridis* (a cross between *S. fragilis* and *S. alba*), the cricket-bat willow, *S. alba* var. *coerulea*, on which the disease had not previously been recorded, and *S. babylonica*. No galls were found on *S. triandra*, *S. purpurea*, *S. viminalis* or *S. caprea*. On the whole, the injury due to them was negligible, although occasionally young trees of *S. fragilis* appeared to be checked in their growth when heavily attacked.

The author points out that Warburton's statement that the disease occurred for the first time in England in 1928 [*R.A.E.*, A **17** 408] is erroneous, as it was observed in Essex about 1906, in Essex and Gloucestershire in 1911, and in the London area in 1915.

CANN (F. R.). **Experiments in Great Britain with Wood Preservatives for the Prevention of *Lyctus* Attack.**—*Forestry* **14** no. 1 pp. 27–37, 20 refs. London, 1940.

Since heat sterilisation of timber against *Lyctus* [*cf. R.A.E.*, A **25** 669] does not prevent subsequent infestation, investigations were

carried out in the laboratory in England to find a suitable preservative that could be applied to seasoned timber immediately after heat treatment [*cf.* **25** 51; **26** 190; **28** 451]. They were chiefly concerned with water-soluble preservatives that do not stain the wood and are cheap, and the test insect was *Lyctus brunneus*, Steph. The samples were oak sapwood seasoned beforehand to a moisture content of 12–15 per cent., and most of them were treated by superficial applications of unheated solutions by brush, spray or immersion for short periods. All samples were weighed immediately before and after treatment, and the amount of preservative absorbed was determined. Those treated with water-soluble preservatives were usually exposed to the beetles within a few weeks of treatment, whereas in the case of oil or solvent preservatives the interval was longer and in some instances extended over a year or more. Small samples ($3 \times 1 \times \frac{1}{2}$ in.) were periodically examined after exposure by cutting portions of the wood off and examining them for eggs and dead or living larvae. Large samples ($6 \times 4 \times 1$ in.) were usually left unexamined for 6 months or more and then inspected superficially by planing the surfaces to expose living or dead larvae and later for the presence or absence of adult exit-holes.

The results are given in a table showing the preservatives, the type of treatment, the concentrations tested and their effectiveness or otherwise in preventing any considerable amount of tunnelling by the newly hatched larvae. It was found that surface application of cold solutions of water-soluble salts by spraying or dipping are of no value for the protection of timber from *Lyctus* attack; but, when applied by impregnating the wood under pressure, sodium fluoride, borax and zinc chloride were effective at concentrations of 0·1, 0·5 and 3 per cent., respectively. As damage by *Lyctus* was not prevented when these preservatives were applied by immersion for 30 seconds or 5 minutes, though the concentrations used were much higher, it is evident that penetration was insufficient; it was not satisfactorily increased by heating the wood immediately before immersion or by adding a wetting agent to the solution. Immersion in a solution of potassium chromate was ineffective even when the immersion-period was prolonged to 24 hours.

In the case of preservatives of the oil-type, immersion for 10 seconds in unheated orthodichlorobenzene or a single brush treatment with any of four fractions of low-temperature tar phenols was effective, whereas kerosene or turpentine, alone or mixed, were of no value. Immersion for 5 minutes in an unheated mixture of 1 part creosote and 2 parts kerosene prevented attack, but an increase in the proportion of kerosene to reduce the stain caused by the creosote decreased the effectiveness of the mixture. Good results were also given by many preservatives of the solvent type, including proprietary preparations containing such substances as metallic naphthenates and a chlorinated naphthalene wax (Seekay Wax R.93). The latter was still effective 9 months after the wood had been immersed for 5 minutes in a 20 per cent. solution in benzene [*cf.* **26** 190].

LEVER (R. J. A. W.). **Entomological Notes.**—*Agric. J. Fiji* **11** no. 1 pp. 16–19, 18 refs. Suva, 1940.

Cotton in Fiji is attacked by an undescribed species of *Empoasca* that sometimes delays ripening for as long as two months and, in

cases of heavy infestation early in the season, causes permanent injury to the young plants. Damage is most severe during the wet season (January–April), and the Jassid generally disappears with the onset of dry weather in May or June. It is believed to be indigenous on jungle plants in Fiji, but as recently as 1926 was apparently of no economic importance. Sea Island cotton is very susceptible to attack, but several varieties grown in Fiji are resistant. Applications of a spray containing 1 pint Bordeaux mixture, either alone or mixed with nicotine sulphate, in 100 gals. water are recommended for control in cases of heavy infestation.

Heliothis armigera, Hb., which was recorded in Fiji on Para grass [*Panicum barbinode*] in 1921 [*R.A.E.*, A **10** 215] and on tomato 4 years later, was observed on maize cobs during 1939. It is believed to have been introduced in September 1939 in commercial seed maize from New South Wales. A spray containing 1½ lb. calcium arsenate in 40 gals. water injured the leaves, and the addition of an equal quantity of lime to the calcium arsenate or the substitution of an equal quantity of lead arsenate is therefore recommended. Other control measures comprise applications, by sprinkling with a large brush, of ½ lb. lead arsenate and 1 gal. molasses, each mixed separately in water, and made up to 6 gals. with water, or the use of calcium-arsenate dust, with or without hydrated lime, at the rate of 4 lb. per acre. A species of *Apanteles* that was recorded as a parasite of the larvae in 1925 and the Vespid, *Polistes macaensis*, F., which was observed to feed on them in October 1939, are not considered likely to exert effective control. Though the larvae usually pupate in the soil, some have been observed to pupate within the maize cobs in Fiji.

Pests intercepted in 1939 included *Cryptorrhynchus mangiferae*, F., in mango seeds received from India in July, *Bruchus analis*, F., and *B. pisorum*, L., in cowpeas and broad beans, respectively, from Cyprus, *B.* (*Bruchidius*) *obtectus*, Say, in dwarf beans (*Phaseolus*) from New South Wales, and *B. pruininus*, Horn, in seeds of *Desmanthus virgatus* from Honolulu.

Summary of a Report on the Recent Mission of Mr. H. W. Simmonds to Java, Malaya, Mauritius and Madagascar.—*Agric. J. Fiji* **11** no. 1 p. 21. Suva, 1940.

Part of this summary deals with a search for parasites and predators suitable for introduction into Samoa against *Oryctes rhinoceros*, L., on coconut. *Catoscopus facialis*, Wied., was found to attack the young larvae in Malaya, and a consignment of this Carabid was successfully shipped to Samoa [*R.A.E.*, A **27** 641]. Investigations in Malaya failed to show that *Scolia ruficeps*, Sm., was a true parasite of the larvae, though it is possible that a biological race of the Scoliid may be able to develop in them [*cf.* **25** 195]. Since it has been shown in Java that *S. oryctophaga*, Coq., from Madagascar and Mauritius is able to breed in *O. rhinoceros*, collections were made in the latter two islands, as a result of which 412 adult females and about 15 pupae were shipped to Samoa. Of the females, 180 were sent by air to Sydney and from thence by sea. They were provided with a jelly consisting of 300–320 cc. honey and 6–8 gm. agar in 200 cc. water and arrived in excellent condition, 150 flying strongly away. The rest of the females and the pupae were sent by sea, and despite the length of the journey, 63 of the females survived. *S. ruficornis*, F., a native of Zanzibar, might

prove a more effective parasite, as it appears to breed continuously, whereas *S. oryctophaga* seems to be single-brooded. Six females taken in the field readily attacked larvae of *O. rhinoceros* in the laboratory, but circumstances prevented further investigation of the species.

PESCOTT (R. T. M.). **A Capsid Plant Bug attacking Stone Fruits.**—*J. Aust. Inst. agric. Sci.* **6** no. 2 pp. 101–102, 1 fig., 7 refs. Sydney, 1940.

The Capsid, *Megacoelum modestum*, Dist., recorded as attacking peaches and nectarines in New South Wales [*cf. R.A.E.*, A **27** 449; **28** 606] and as a minor pest of cotton and vegetables in Queensland, has recently caused considerable damage to stone fruits in the north-eastern part of Victoria. It attacked cherries, nectarines and peaches, the most serious damage resulting to late peaches of the Elberta type. There was no evidence that apples and pears were attacked. The damage is caused by the adults, and as many as six may be found on a single fruit. They usually feed in sheltered positions, numerous deep punctures being made in the fruits. Severe gumming occurs on the surface of Elberta peaches and the fruit finally drops. In other varieties of peach, injury is visible as dark spots on the skin beneath which are brown corky areas. When the fruit is attacked early, growth ceases at the points of attack. No apparent damage was caused to the foliage on young shoots.

MAGEE (C. J. P.). **Transmission Studies on the Banana Bunchy-top Virus.**—*J. Aust. Inst. agric. Sci.* **6** no. 2 pp. 109–110, 3 refs. Sydney, 1940.

A summary is given of recent work in Australia on the transmission of the virus causing bunchy top of banana [*cf. R.A.E.*, A **16** 66], which has a specific Aphid vector, *Pentalonia nigronervosa*, Coq., and is destructive only to species of the genus *Musa*. Attempts to transmit it by mechanical inoculations have been unsuccessful. Efficient transmission has been obtained with both winged and wingless agamic viviparae of the Aphid, and with each of the four nymphal instars preceding each of the adult forms. These are the only forms in which the Aphid occurs. Approximately 46 per cent. of 233 individuals of all stages, fed as nymphs on recently infected plants, have transmitted the disease in subsequent trials. Adults fed on infected leaves acquire the virus much less frequently than nymphs. Nymphs carry the virus through their moults, but it is not transmitted by infective adults to their progeny.

Infection apparently occurs when a minimal dosage of the virus reaches the plant, as an increase in number of infective Aphids during inoculation affects only frequency of infection and not the severity of symptoms or the minimum incubation period. The virus is not transmitted by infective Aphids that feed for less than 1½–2 hours on susceptible plants. For acquisition of the virus (by nymphs), an unusually long period, of a minimum of 17 hours, is required; to obtain a high percentage of acquisition, a feeding period of 24 hours is advisable. Temperatures of 10 and 15°C. [50 and 59°F.], by retarding the activities of infective Aphids and their inclination to feed, reduced the number of successful inoculations obtained under the conditions

of the experiments, and may be of some importance in determining the low winter incidence of the disease. The virus can be retained by infective Aphids in daily transfers to fresh plants for periods as long as 13 days after removal from infected plants. During this infective period, most, but not all, of the plants infested contract the disease, indicating that special requirements besides the mere feeding of infective Aphids on the leaves of young plants are necessary for transmission.

There is a delay or waiting period in the development of infective power by *P. nigronervosa* after feeding on infected plants. The duration of this period seems to depend on the individual, and to vary from a few hours to approximately two days. The position of inoculation by infective Aphids on the leaves of young plants does not greatly influence the rate of infection or the incubation period of the disease. In infected leaves detached from plants and maintained in a fresh condition, the presence of the virus can be demonstrated after a lapse of at least 12 days. Although the virus causes systematic infection, it does not pervade infected plants. Its presence has been demonstrated only in the first-symptom leaf or leaves subsequently developed. Within the first-symptom leaf, which usually contains relatively few virus channels, as indicated by the presence of green streaks or vascular bundles showing abnormal phloem structure, the virus is present only in the region of these abnormal areas. Ageing of infected plants, if accompanied as usual by pronounced retardation in growth rate, leads to a pronounced fall in availability of the virus. Such plants may be stimulated to more rapid leaf-production by improving their environment, and again rendered highly infectious.

BRIMBLECOMBE (A. R.). **Determination of Starch Content of Spotted Gum Trees.**—*J. Aust. Inst. agric. Sci.* **6** no. 2 pp. 110–113, 4 refs. Sydney, 1940.

In view of the fact that the degree to which timber is infested by *Lyctus* increases with its starch content [*cf. R.A.E.*, A **24** 551, etc.] and the importance of the *Lyctus* problem in Queensland, starch studies have been carried out for some time there, especially in relation to *Eucalyptus maculata*, a species of commercial importance that stores large quantities of starch in its sapwood. A simple method of testing its sapwood for starch content, accurate enough to enable five grades of starch intensity to be recognised, is described, and the results of its application to samples taken at different heights and aspects on a number of trees are shown in tables. It is concluded from these that samples taken at breast height from normally growing trees should give a fairly accurate idea of the starch content throughout the bole at the time of sampling, and it should be safe to draw reliable conclusions from two such samples taken on different aspects.

DUMBLETON (L. J.). *Tortrix postvittana* **Walk. and its Parasites in Australia.**—*N.Z. J. Sci. Tech.* (A) **21** no. 6 pp. 322A–336A, 32 figs., 10 refs. Wellington, N.Z., 1940.

Tortrix postvittana, Wlk., is a polyphagous Tortricid that has become a major pest of apple in Tasmania and certain parts of New Zealand. It is indigenous to Australia and occurs in all the apple-growing areas

there, but it is not a pest in Queensland or Western Australia and is of minor importance in South Australia, New South Wales and all but a few districts of Victoria. It does not occur in the Northern Territory. It is chiefly found in a belt round the coast extending inland about 200 miles at the widest point. Its importance in Tasmania is probably due to the fact that relatively few arsenical cover sprays are employed there against the codling moth [*Cydia pomonella*, L.], which has only one generation a year as compared with two on the mainland, but its lack of importance in Queensland and Western Australia is believed to be due to some climatic or biotic factor, since arsenical sprays are not used on apple in Western Australia, where *C. pomonella* does not occur. In both Australia and New Zealand, *T. postvittana* is a major pest only in areas where the mean annual temperature is between 50 and 55°F., the mean monthly temperature is not lower than 43°F., and the precipitation evaporation ratio exceeds 0·5 during 7–12 months of the year [*cf. R.A.E.*, A **25** 450]. In the central Otago district of New Zealand, where the mean annual temperature is 50°F., the mean monthly temperature in June and July 36·5°F., and the annual rainfall less than 20 ins., it is largely replaced by the indigenous *T. excessana*, Wlk. [**26** 57]; the scarcity of leafy evergreens in this district may also contribute towards the prevention of outbreaks of *T. postvittana*. Its bionomics in New Zealand and Tasmania are briefly discussed with reference to food-plants and sources of re-infestation of orchards in spring [**21** 91; **25** 295]. It is believed that in New Zealand the species does not overwinter in the orchards.

Several parasites of *T. postvittana* have been recorded in New Zealand [**21** 92; **24** 209], and during February 1937, collections were made in Tasmania with a view to finding others suitable for introduction. The collected material was dispatched to Adelaide, where the *Tortrix* larvae were fed to secure the emergence of all parasites present and the Tachinid puparia and parasitised pupae were kept in cool storage until 6th May; they were then taken to New Zealand, and were again placed in cool storage, where the puparia were kept until October and the parasitised pupae until mid-November. In all, nine Hymenopterous parasites and two Tachinids were reared, and brief descriptions are given of various stages of these, with notes on their biology, so far as it is known. The percentage parasitism among a total of about 700 larvae did not exceed 15; the Tachinid, *Voriella uniseta*, Mall., all the immature stages of which are described in detail, was responsible for 7 per cent., and an undescribed Tachinid of the genus *Phorocera* for 3 per cent. The other larval parasites were the Braconids, *Apanteles tasmanica*, Cam., and *Meteorus dumbletoni*, Mues. [**28** 82], *Eupsenella diemenensis*, Dodd (which may be the Bethylid referred to by Nicholls as *Goniozus antipodum*, Westw. [**22** 477]) and the Ichneumonids, *Agathiella meridionalis*, Turner, *Phytodietus celsissimus*, Turner, and a species of a genus allied to *Glypta*. *Apanteles tasmanica* already occurs in New Zealand [**24** 209], where it is the dominant parasite of *T. postvittana* and is more abundant than in Tasmania; a hyperparasite, *Hemiteles* sp., was bred from a cocoon collected in Tasmania. The percentage parasitism among the pupae was about 20; *Xanthopimpla rhopaloceros*, Krieger, and *Brachymeria* (*Chalcis*) sp. each parasitised about 8 per cent. of the pupae, and an undetermined Ichneumonid also occurred.

On the basis of their frequency in Tasmania, the most suitable parasites for introduction into New Zealand are considered to be

V. uniseta, *Brachymeria* sp. and *X. rhopaloceros*. J. W. Evans has obtained adults of *V. uniseta* in Tasmania in February, July, August and November and has informed the author that adults have emerged in early spring from overwintering larvae. About 50 per cent. of the puparia and 25 per cent. of those of the other Tachinid survived their exposure to a temperature of 40°F. for 8 months, but neither species oviposited, though two males and four females of *Voriella* lived in cages for 20 days under winter conditions and attempts to mate were observed. A pupa of *Voriella* collected in the field in Tasmania was destroyed by the larva of a Hymenopterous hyperparasite.

Papers noticed by Title only.

Takahashi (Y.). **On the Morphology of the Adult of** *Chlorops oryzae* **Mats.** [*In Japanese.*]—*J. Plant Prot.* **27** no. 6 pp. 396–402, 1 pl. Tokyo, 1940.

Okamoto (D.). **Observations on** *Galerucella distincta* **Baly** [on strawberry in Korea]. [*In Japanese.*]—*Rep. agric. Exp. Sta. Korea* **11** no. 1 pp. 75–85, 1 pl. Suigen, 1939. [Recd. 1941.] [*Cf. R.A.E.*, A **27** 619.]

Hoffmann (W. E.). **The Foodplants of** *Nezara viridula* **Linn. (Hem. Pent.)** [a list of over 100 species from the literature].—*VI Congr. int. Ent. Madrid 1935* **2** pp. 811–816. Madrid, 1940.

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